Fishery Data Series No. 12-03

Chinook and Coho Salmon Escapement in the Chena, Delta Clearwater, Goodpaster and Salcha Rivers, 2007–2009

by

James W. Savereide

February 2012

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$log_{2,}$ etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 12-03

SALMON STUDIES IN THE CHENA, DELTA CLEARWATER, GOODPASTER AND SALCHA RIVERS, 2007–2009

By
James W. Savereide

Division of Sport Fish, Fairbanks

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

February 2012

Development and publication of this manuscript were partially financed by the Federal Aid in Sport fish Restoration Act (16 U.S.C.777-777K) under Project F-10-23, 24 and 25, Job No. S-3-1(a)

ADF&G Fishery Data Series was established in 1987 for the publication of Division of Sport Fish technically oriented results for a single project or group of closely related projects, and in 2004 became a joint divisional series with the Division of Commercial Fisheries. Fishery Data Series reports are intended for fishery and other technical professionals and are available through the Alaska State Library and on the Internet: http://www.adfg.alaska.gov/sf/publications/. This publication has undergone editorial and peer review.

James W. Savereide,
Alaska Department of Fish and Game, Division of Sport Fish
1300 College Road, Fairbanks, AK 99701-1599, USA

This document should be cited as:

Savereide, J. W. 2012. Salmon studies in the Chena, Delta Clearwater, Goodpaster and Salcha rivers, 2007-2009. Alaska Department of Fish and Game, Fishery Data Series No. 12-03, Anchorage.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Salmon enumeration projects in the Tanana River drainage were conducted by the Alaska Department of Fish and Game on the Chena and Delta Clearwater rivers during 2007–2009. Chinook salmon *Oncorhynchus tshawytscha* escapements on the Chena River were estimated using tower-count methodology. Chum salmon *O. keta* were also enumerated, but counting was terminated prior to the end of the runs so escapement estimates represent minimums. Age and sex compositions of Chinook salmon were estimated from samples of carcasses. Coho salmon *O. kisutch* escapements on the Delta Clearwater River were enumerated by visual counts during roving boat surveys and are considered minimum estimates of total escapement. The Chena River tower was in operation from 28 June through 4 August, 2007; 30 June through 28 July, 2008; and 5 July through 8 August, 2009. Estimated Chinook salmon escapements were 3,806 (SE=226) in 2007, 3,208 (SE=198) in 2008, and 5,253 (SE=231) in 2009. Minimum estimates of chum salmon escapement were 4,999 (SE=395) in 2007, 1,300 (SE=106) in 2008, and 16,516 (SE=643) in 2009. Estimated proportions of female Chinook salmon in the Chena River escapement were 0.39 (SE=0.05) in 2007, 0.41 (SE=0.08) in 2008, and 0.57 (SE=0.02) in 2009, and the estimated proportions adjusted for gender-selective sampling were 0.27 (SE=0.05) in 2007, 0.29 (SE=0.06) in 2008, and 0.40 (SE=0.08) in 2009. Eighty percent of females were age classes 5 and 6 in all years, while males were fairly evenly distributed across age classes 3–6. Minimum escapements of coho salmon in the Delta Clearwater River were 14,650 in 2007, 7,500 in 2008, and 16,850 in 2009.

Chinook salmon tower enumeration projects were also conducted during 2007–2009 on the Salcha and Goodpaster rivers by Bering Sea Fishermen's Association and Tanana Chiefs Conference, respectively. Summaries from those projects are included in this report as a means of archiving the data and estimates. The Salcha River tower was in operation from 30 June through 5 August, 2007; 5 July through 10 September, 2008; and 6 July through 10 August, 2009. Estimated Chinook salmon escapements were 6,425 (SE=225) in 2007, 2,731 (SE=169) in 2008, and 12,774 (SE=405) in 2009. The 2007 estimate is a minimum because a large number of counts were missed due to flood events and no interpolation for missed days is included in this report. Minimum estimates of chum salmon escapement were 13,069 (SE=295) in 2007, 2,212 (SE=94) in 2008, and 31,035 (SE=800) in 2009. Estimated proportions of female Chinook salmon in the Salcha River escapement were 0.36 (SE=0.03) in 2007, 0.39 (SE=0.03) in 2008, and 0.39 (SE=0.02) in 2009, and the estimated proportions adjusted for gender-selective sampling were 0.31 (SE=0.07) in 2007, 0.34 (SE=0.07) in 2008, and 0.34 (SE=0.07) in 2009. The Goodpaster River counting tower was in operation from 16 July through 27 July, 2007; 8 July through 29 July, 2008; and 7 July through 30 July, 2009. Estimated Chinook salmon escapements were 1,581 (SE=82) in 2007, 1,880 (SE=85) in 2008, and 4,280 (SE=167) in 2009. The 2007 estimate is a minimum because a number of counts were missed at the beginning of the run due to flood events.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, chum salmon, *Oncorhynchus keta*, coho salmon, *Oncorhynchus kisutch*, Chena River, Salcha River, Goodpaster River, Delta Clearwater River, counting tower, escapement, age composition, sex composition.

INTRODUCTION

The primary purpose of this report is to present findings from salmon escapement enumeration projects in the Tanana River drainage conducted by the Alaska Department of Fish and Game-Sport Fish Division (ADFG-SFD), during 2007-2009. These projects included a counting tower enumeration project on the Chena River to estimate total escapement of Chinook salmon *Oncorhynchus tshawytscha* and partial escapement of chum salmon *O. keta*, and a roving boat survey count to estimate escapement of coho salmon *O. kisutch* on the Delta Clearwater River.

Secondarily, this report presents data summaries and estimates of escapement of Chinook salmon from counting tower projects conducted during 2007–2009 by Bering Sea Fisherman's Association (BSFA) on the Salcha River and by Tanana Chiefs Conference (TCC) on the Goodpaster River. Information from these two projects is in this report at the request of BSFA and TCC as a means of archiving the count data and escapement estimates in a publication that is easily accessible by stakeholders and other researchers. Information pertinent to the Salcha and Goodpaster rivers enumeration studies are found in Appendices A and B.

CHENA RIVER CHINOOK SALMON

The Yukon River drainage is the largest river system in Alaska and contains dozens of rivers and streams that support spawning Chinook salmon. These rivers are spread throughout the drainage with lower basin spawning streams being separated from upper basin streams in Canada by more than 2,000 rkm. The upper basin, primarily Canadian streams, accounts for approximately half the total production of Chinook salmon in the drainage, while streams in the Tanana River drainage account for approximately one quarter of the total production (Eiler et al. 2004, 2006a, 2006b). Within the Tanana River drainage, the largest spawning populations return to the Salcha, Chena, Goodpaster, Kantishna, Chatanika, and Nenana rivers.

Commercial, subsistence, sport, and personal use fishing occurs throughout the Alaskan portion of the Yukon River in each of six districts, and these fisheries harvest a mixture of spawning stocks. Total annual utilization of Chinook salmon in the Yukon River drainage (including Canadian fisheries) has exceeded 200,000 fish in past years, but recent (2004–2008) annual harvests have averaged approximately 95,000 fish (JTC 2009). Participation and harvest in sport fisheries is low in most of the Yukon River drainage with the exception of the Tanana River drainage where popular sport fisheries occur in the lower 3 rkm of the Salcha River and in the lower 72 rkm of the Chena River. The recent 5-yr (2004–2008) average sport catch of Chinook salmon in the Chena River was 1,527 fish and the average sport harvest was 262 fish, while in the Salcha River the recent 5-yr average sport catch was 943 fish and the average sport harvest was 339 fish (Jennings et al. 2007, 2009 a, b, 2010 a, b).

Management of Yukon River Chinook salmon is facilitated by a variety of run assessment projects spread across the drainage that are conducted by a number of agencies. Managers are reliant inseason on a variety of inriver run assessments operated by Alaska Department of Fish and Game-Commercial Fisheries Division (ADFG-CFD) including test fisheries near the mouth of the Yukon River, at the Rapids in the middle River near Rampart, and in the Tanana River near Nenana. Run strength assessments also come from subsistence and commercial fishery catch data, a sonar enumeration project at Pilot Station in the lower river, and a sonar enumeration project near Eagle in the upper river near the Alaska-Canada border. Spawning escapement monitoring projects are conducted by the U.S. Fish and Wildlife Service in the Andreafsky River and Gisasa River, by TCC in Henshaw Creek and Goodpaster River, by BSFA in the Salcha River, and by ADFG-SFD in the Chena River. Escapement monitoring projects have been conducted annually on the Chena, Salcha, and Goodpaster rivers since 1986, 1987, and 2004, respectively.

In 2001, the Alaska Board of Fisheries (BOF) directed ADF&G to establish escapement goals for all actively managed stocks for which adequate data exist. Biological escapement goals (BEGs) of 2,800–5,700 Chinook salmon in the Chena River and 3,300–6,500 in the Salcha River were established by ADF&G to provide for maximum sustained yield. There are currently no escapement goals for any other Tanana River drainage Chinook salmon stocks.

DELTA CLEARWATER RIVER COHO SALMON

The Delta Clearwater River (DCR) is a spring-fed tributary to the Tanana River located near Delta Junction, about 160 km southeast of Fairbanks (Figure 1). Length of the mainstem is about 32 rkm, the north fork is approximately 10 rkm in length, and there are a number of shallow spring areas adjacent to the main channel.

The DCR has the largest known coho salmon escapements in the Yukon River drainage (Parker 1991). Spawning occurs throughout the main channel and in the spring areas. Before reaching the spawning grounds of the DCR, coho salmon travel about 1,700 rkm from the ocean and pass through several different commercial fishing districts in the Yukon and Tanana rivers. Subsistence or personal use fishing also occurs in each district.

Coho salmon in the DCR support a popular fall sport fishery with a daily bag and possession limit of three fish. The average annual harvest exceeded 1,000 coho salmon from 1986–1991. In recent years, catch has been high but harvest has been relatively low (Parker 2006).

Historically, escapements of coho salmon into the DCR have been monitored by counting fish from a drifting riverboat (Parker 1991). From 1994–1998 aerial surveys (using a helicopter) were also conducted to estimate escapement in portions of the river not accessible by boat (Evenson 1995, 1996; Evenson and Stuby 1997; Stuby and Evenson 1998; Stuby 1999-2001). Escapement information is used to evaluate management of the commercial, subsistence, and personal use fisheries, in addition to regulating the sport harvest of coho salmon by opening and closing the season and changing the bag limit. In 2003 the Alaska Board of Fisheries established a sustainable escapement goal (SEG) range of 5,200–17,000 coho salmon for the DCR (measured with boat counts; Parker 2006).

OBJECTIVES

The objectives in 2007–2009 were to:

1. estimate the total escapement of Chinook salmon in the Chena River using tower-counting techniques;
2. estimate age and sex compositions of the escapement of Chinook salmon in the Chena River; and,
3. count coho salmon in the Delta Clearwater River to obtain a count of the minimum escapement.

In addition to the objectives there were two tasks:

4. measure the length of carcasses sampled pursuant to Objective 2 to contribute to a database for Arctic-Yukon-Kuskokwim River salmon for general use; and,
5. count chum salmon in the Chena River throughout the duration of the Chinook salmon run.

METHODS

CHENA RIVER CHINOOK SALMON

Daily escapements of Chinook and chum salmon were estimated by visually counting fish as they passed over white fabric panels located on the river bottom on the upstream side of the Moose Creek Dam on the Chena River (Figure 1). Personnel on the deck of the dam counted all salmon passing upstream and downstream for 20 minutes every hour over the course of the run. Lights were suspended over the panels to provide illumination during periods of low ambient light. Counting began on or about 25 June each year and continued into August until there were three continuous days with no net upstream passage of Chinook salmon. Virtually all Chinook salmon spawning occurs upstream of this site and no harvest of salmon is allowed upstream of the dam, so final estimates represent total escapement.

Five technicians were assigned to enumerate the salmon escapement in the Chena River. Each day was divided into three 8.0-h shifts. Shift I began at 0000 hour (midnight) and ended at0759 hour; Shift II began at 0800 hour and ended at 1559 hour; Shift III began at 1600 hour and ended at 2359 hour. The start time for all counts began between the top of the hour and 10 min past. In 2007 and a portion of 2008 the Chena River was bisected by placing a red strip across the white panels near the center of the channel, and 10 min counts were conducted on each side. The count on the north side of the river was conducted first with the count on the south side immediately following. For the latter half of 2008 and all of 2009, a single 20 min count of the entire channel was made each hour of the day.

The numbers of Chinook and chum salmon were recorded on field forms at the end of each count. In addition, technicians would evaluate and record the water clarity conditions (Table 1) as well as the river height from a staff gauge mounted on the dam. Only counts with a rank of 3 or higher were used in the estimate of escapement. A count with a rank of 4 or 5 was considered as no count. Each day, the data sheets from the previous day were returned to the project leader at the end of Shift I.

In addition to the tower counts, scales from carcasses of spawned-out Chinook salmon were collected during the first two weeks of August from the dam upriver to the first bridge (Figure 1) to estimate age and sex composition of the escapement. Lengths were also measured. Ages were determined from scale patterns as described by Mosher (1969). Three scales were removed from the left side of the fish approximately two rows above the lateral line along a diagonal line downward from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Welander 1940). If no scales were present in the preferred area due to decomposition, scales were removed from the same area on the right side of the fish or if necessary, from any location other than along the lateral line where there are any scales remaining.

Table 1.–Water clarity classification.

Rank	Description	Salmon Viewing	Water Condition
1	Excellent	All passing salmon are observable	Virtually no turbidity or glare, “drinking water” clarity; all routes of passage observable
2	Good	All passing salmon are observable	Minimal to moderate levels of turbidity or glare; all routes of passage observable
3	Fair	Possible, but not likely, that some passing salmon may be missed	Moderate to high levels of turbidity or glare; a few likely routes of passage are partially obscured
4.	Poor	Likely that some passing salmon may be missed	Moderate to high levels of turbidity or glare; some-many likely routes of passage are obscured
5	Un-observable	Passing fish are not observable	High level of turbidity or glare; ALL routes of passage obscured

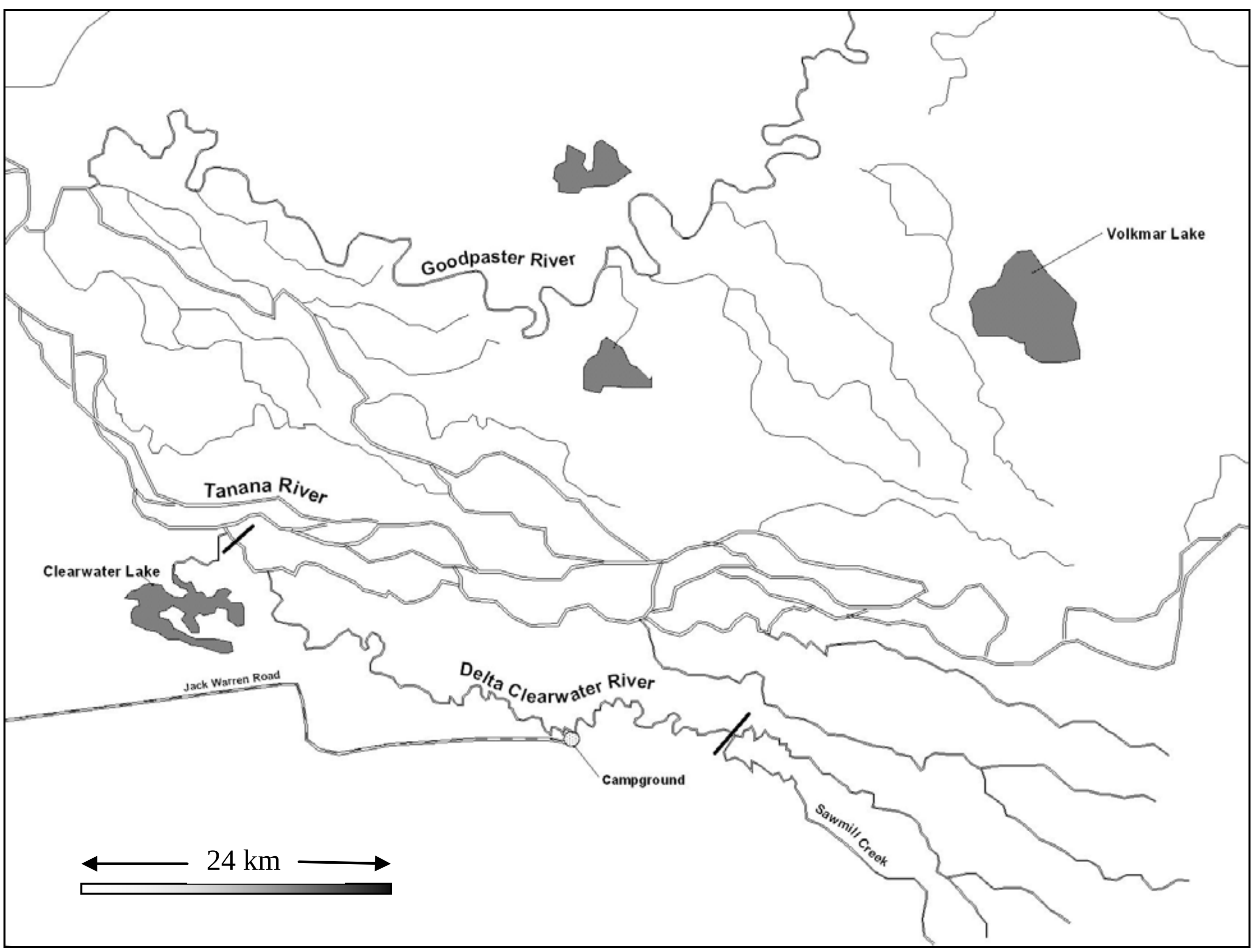

Figure 1.–Map of the Delta Clearwater River demarcating the survey area (bold lines).

Two riverboats with three people in each boat (one operator and two people collecting carcasses) were used to collect Chinook salmon carcasses. Chinook salmon carcasses were speared from the boats and collected along banks and gravel bars. All deep pools and eddies that could be safely explored were inspected to find and sample as many Chinook salmon carcasses as possible. After collection, the carcasses were placed in a large tub onboard the boat. Once the tub was full, the boat would land on a gravel bar and the carcasses were laid out in rows of 10 with their left sides facing up. After sampling, all carcasses were cut in a distinctive manner through the left side of the fish to avoid resampling and returned to the river.

DELTA CLEARWATER RIVER COHO SALMON

Previous aerial surveys of the DCR drainage have shown that an average of 20% of the coho escapement is found in areas inaccessible to a boat survey; therefore, counts of adult coho salmon were conducted along the length of river accessible by boat to obtain a minimum estimate of escapement. This estimate was used to evaluate whether or not the SEG was met. Two persons (a boat operator and a counter) conducted the survey from a drifting river boat equipped with a 5 ft elevated platform. The survey is typically done during peak spawning times over the course of 1 to 2 days. The survey was conducted along the lower 18 miles of the Delta Clearwater River to within 1.0 mile of the Clearwater Lake outlet (Figure 2). The total number of coho salmon observed (both dead and alive) were recorded every mile at mile markers posted on the river bank. The sum of the section counts equaled the estimate of minimum escapement.

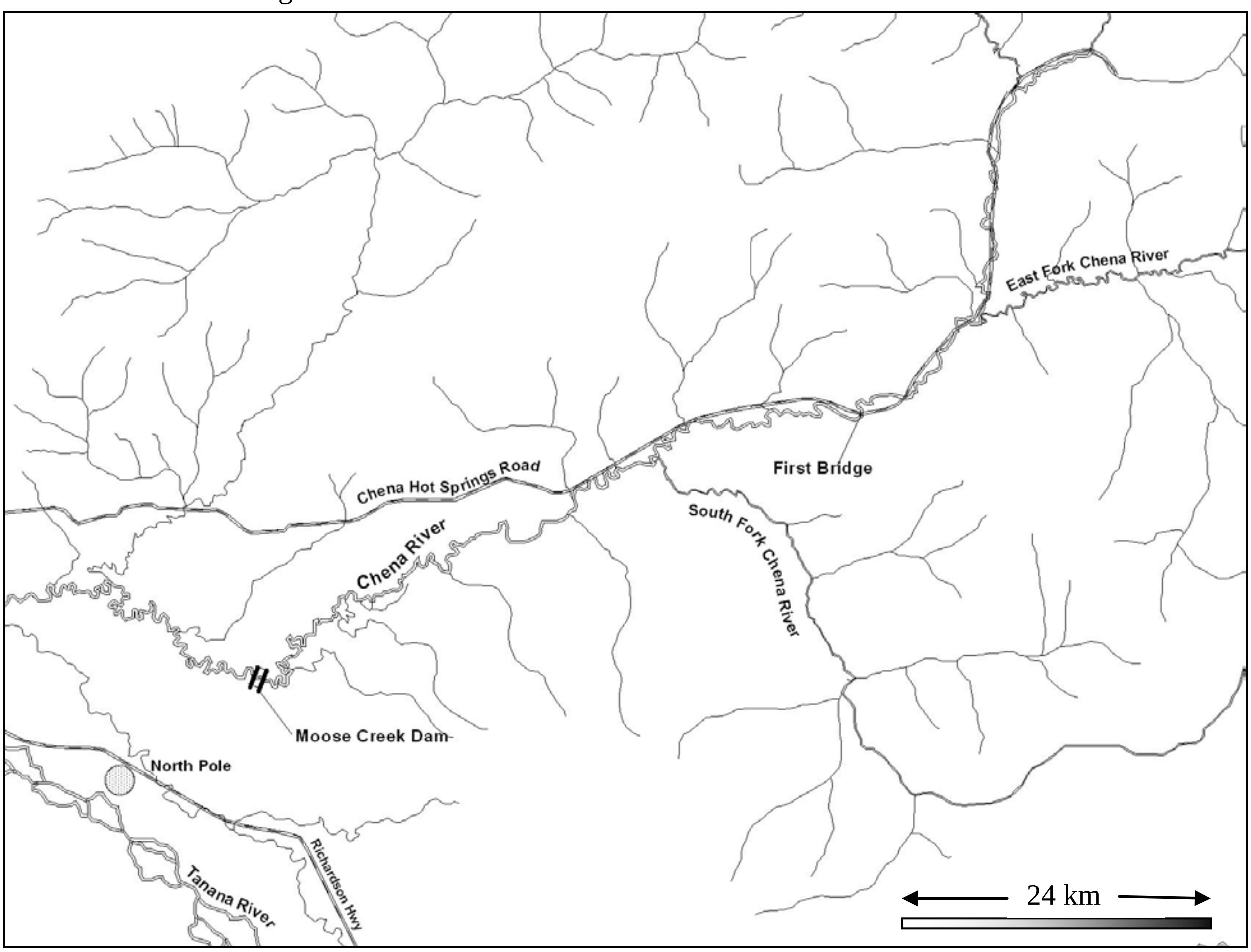

Figure 2.–Map of the Chena River demarcating the Moose Creek Dam and the first bridge on Chena Hot Springs Road.

DATA ANALYSIS (CHENA RIVER CHINOOK SALMON)

Estimates of Chinook salmon escapement were stratified by day. Daily estimates of escapement were considered a two-stage direct expansion where the first stage was 8-h shifts within a day and the second stage was 10 (or 20) min counting periods within a shift. On 10 July 2008, the methods were changed to count the whole river for 20 minutes an hour versus each half of the river for 10 minutes an hour. The second stage was considered systematic sampling because the counting periods were not chosen randomly. The formulas necessary to calculate escapement from counting tower data were taken directly or modified from those provided in Cochran (1977). The expanded shift escapement on day *d* and shift *i* was calculated by:

$$Y_{di} = \frac{M_{di}}{m_{di}} \sum_{j=1}^{m_{di}} y_{dij} . \qquad (1)$$

Escapement and its variance were not estimated for each side of the river then combined; instead the side-specific counts within each hour are summed to represent a 10-min count for the entire river (i.e., the y_{dij}'s are entire river 10-min counts). Because the counts on each side of the river during a given hour were not independent, there would be a need to account for covariance terms if variance estimates for each side were first calculated and then combined to estimate the variance for the entire river's escapement.

The average shift escapement for day *d* would be:

$$\bar{Y}_d = \frac{\sum_{i=1}^{h_d} Y_{di}}{h_d} . \qquad (2)$$

The following criteria were established to determine the methods used to estimate the daily escapement and its variance:

1. when two or more shifts are considered complete, escapement and variance was estimated using equations 3-8;
2. when counts were only conducted during one shift but all 8 counting periods were sampled, escapement was estimated using equation 3 and variance was estimated using equation 11; and,
3. when no shifts were considered complete, interpolation techniques described in equations 12 and 13 were used to estimate escapement and equation 11 was used to estimate variance.
4. A minimum of 4 counting periods per shift was required for a complete shift. Counts were conducted during all scheduled counting periods unless water clarity conditions prohibited counts.

The expanded daily escapement was:

$$\hat{N}_d = \bar{Y}_d H_d . \qquad (3)$$

The period sampled was systematic, because a period was sampled every hour in a shift. The sample variance associated with periods is approximate using the successive difference approach:

$$s_{2di}^2 = \frac{1}{2(m_{di}-1)} \sum_{j=2}^{m_{di}} \left(y_{dij} - y_{di(j-1)}\right)^2 . \qquad (4)$$

Shift sampling was random. The between shift sample variance was calculated as:

$$s_{1d}^2 = \frac{1}{h_d - 1} \sum_{i=1}^{h_{sd}} \left(Y_{di} - \bar{Y}_d\right)^2 . \qquad (5)$$

The variance for the expanded daily escapement was estimated by:

$$\hat{V}\left(\hat{N}_d\right) = \left[(1 - f_{1d}) H_d^2 \frac{s_{1d}^2}{h_d}\right] + \left[\frac{1}{f_{1d}} \sum_{i=1}^{h_d} \left((1 - f_{2di}) M_{di}^2 \frac{s_{2di}^2}{m_{di}}\right)\right] \qquad (6)$$

where:

$$f_{1d} = \frac{h_d}{H_d}\text{; and,} \qquad (7)$$

$$f_{2di} = \frac{m_{di}}{M_{di}} \qquad (8)$$

and

d = day;

i = 8-h shift;

j = 10-min counting period;

y_{dij} = observed 20-min count or sum of 10-min period counts (i.e., counts on both sides combined to give a count for the entire river);

Y_{di} = expanded shift escapement;

m_{di} = number of counting periods sampled within a shift;

M_{di} = total number of possible counting periods within a shift;

h_d = number of 8-h shifts sampled within a day;

H_d = total number of possible 8-h shifts within a day; and,

D = total number of possible days.

Total escapement and variance was estimated by:

$$\hat{N} = \sum_{d=1}^{D} \hat{N}_d \text{ ; and,} \tag{9}$$

$$\hat{V}(\hat{N}) = \sum_{d=1}^{D} \hat{V}(\hat{N}_d)\,. \tag{10}$$

Equation 5, the sample variance across shifts, required data from more than one shift per day. In the event that water conditions and/or personnel constraints did not permit at least two shifts during a day, a coefficient of variation (*CV*) was calculated using all days when more than one shift was worked. The average *CV* was used to approximate the daily variation for those days when fewer than two shifts were worked. The coefficient of variation was used because it is independent of the magnitude of the estimate and is relatively constant throughout the run (Evenson 1995). The daily *CV* was calculated as:

$$CV_d = SE_d \big/ \hat{N}_d \;. \tag{11}$$

When k consecutive days were not sampled due to adverse viewing conditions, the moving average estimate for the missing day i was calculated as:

$$\hat{N}_i = \frac{\sum_{j=i-k}^{i+k} I(day\, j \;\; was\, sampled)\hat{N}_j}{\sum_{j=i-k}^{i+k} I(day\;\, j\, was\, sampled)} \tag{12}$$

where:

$$I(\cdot) = \begin{cases} 1 & when\, the\, condition\, is\, true \\ 0 & otherwise \end{cases} \tag{13}$$

is an indicator function. The moving average procedure was only applied to data gaps that did not exceed 4 days (12 consecutive shifts).

Gender-selective sampling has been noted when comparing sex ratios of Chinook salmon collected during carcass surveys with those collected by electrofishing (Stuby 2001). Correcting the estimated sex composition estimates from a carcass survey to estimates we might observe in a completely random sample required analysis of data from previous years when mark-recapture experiments were conducted. Paired electrofishing and carcass survey data from mark recapture studies are available for 8 years from the Chena River (1989–1992, 1995–1997, and 2000). Abundance estimates were generated for each gender and the ratio of the abundance estimate of females to the total abundance was used to generate an unbiased estimate of the proportion of females in the population. A “correction factor” was calculated and applied to the estimated proportion of females in the carcass sample (in years when only carcass samples were collected) based on the average relationship between the proportion estimate from the mark recapture estimates and the proportion estimates from the carcass samples for all 8 years.

The estimated proportions of males and females from carcass surveys were calculated using (Cochran 1977):

$$\hat{p}_{sc} = \frac{y_{sc}}{n_c}; \tag{14}$$

with variance:

$$\hat{V}[\hat{p}_{sc}] = \frac{\hat{p}_{sc}(1-\hat{p}_{sc})}{n_c - 1}; \tag{15}$$

where y_{sc} is the number of salmon of sex s observed during carcass surveys and n_c is the total number of salmon of either sex observed during carcass surveys for $s = m$ or f.

The adjustment necessary to compensate for the gender bias when no electro-fishing was conducted is $\hat{R}_p$ = 0.708 with $\hat{V}(\hat{R}_p)$ = 0.018.

The bias-adjusted estimate and variance (Goodman 1960) of the proportion of females, $\tilde{p}_{fe}$, is:

$\tilde{p}_{fe} = \hat{p}_{fc}\hat{R}_p$ with variance:

$$\hat{V}(\tilde{p}_{fe}) = \hat{p}_{fc}^2\hat{V}(\hat{R}_p) + \hat{R}_p^2\hat{V}(\hat{p}_{fc}) - \hat{V}(\hat{R}_p)\hat{V}(\hat{p}_{fc}) . \quad (16)$$

The estimate and variance of the proportion of males observable during electrofishing are:

$\tilde{p}_{me} = 1 - \tilde{p}_{fe}$ and $\hat{V}(\tilde{p}_{me}) = \hat{V}(\tilde{p}_{fe})$.

Escapement of each sex is then estimated by:

$$\hat{N}_s = \tilde{p}_{se}\hat{N} \quad (17)$$

The variance for $\hat{N}_s$ in this case was (Goodman 1960):

$$\hat{V}\left(\hat{N}_s\right) = \hat{V}\left(\tilde{p}_{se}\right)\hat{N}^2 + \hat{V}\left(\hat{N}\right)\tilde{p}_{se}^2 - \hat{V}\left(\tilde{p}_{se}\right)\hat{V}\left(\hat{N}\right). \quad (18)$$

Typically, the aging system for salmon includes the number of freshwater and ocean years of residence. For example, age 1.2 symbolizes one year of freshwater residence and two years in the ocean. In this study, ages are reported chronologically from the year of spawning to facilitate spawner-recruit analyses- e.g. a fish denoted as 1.2 has one year of freshwater residence, two years ocean residence, and one year for the year of spawning for a total of 4 years.

The proportion of fish at age k by sex s for samples collected solely for age, sex, and length were calculated as:

$$\hat{p}_{sk} = \frac{y_{sk}}{n_s} \quad (19)$$

where: $\hat{p}_{sk}$ = the estimated proportion of Chinook salmon that are age k; ysk = the number of Chinook salmon sampled that are age k; and, ns = the total number of Chinook salmon sampled.

The variance of this proportion was estimated as:

$$\hat{V}\left[\hat{p}_{sk}\right] = \frac{\hat{p}_{sk}\left(1 - \hat{p}_{sk}\right)}{n_s - 1} \quad (20)$$

Escapement at age k for each sex was then estimated by:

$$\hat{N}_{sk} = \hat{p}_{sk}\hat{N}_s \quad (21)$$

The variance for $\hat{N}_{sk}$ in this case was (Goodman 1960):

$$\hat{V}\left(\hat{N}_{sk}\right) = \hat{V}\left(\hat{p}_{sk}\right)\hat{N}_s^{\,2} + \hat{V}\left(\hat{N}_s\right)\hat{p}_{sk}^2 - \hat{V}\left(\hat{p}_{sk}\right)\hat{V}\left(\hat{N}_s\right). \quad (22)$$

RESULTS

CHENA RIVER CHINOOK SALMON

Escapement

In 2007, the Chena River counting tower was in operation from 28 June to 4 August. The estimated escapement of Chinook salmon was 3,806 (SE=226), which was within the established BEG (Table 2, Figure 3). Three days of light rain resulted in less than favorable viewing conditions on 25 and 26 July, which resulted in no counts for those 2 days (Table 3). The estimated chum salmon escapement was 4,999 (SE=395) but this estimate was considered a minimum estimate because tower counts were terminated before the chum run was completed (Table 4).

Table 2.–Estimates of the Chena River Chinook salmon escapement, 1986–2009.

Year	Escapement Estimate	SE	Method
1986	9,065	1,080	Mark-Recapture
1987	6,404	557	Mark-Recapture
1988	3,346	556	Mark-Recapture
1989	2,730	249	Mark-Recapture
1990	5,603	1,164	Mark-Recapture
1991	3,172	282	Mark-Recapture
1992	5,580	478	Mark-Recapture
1993	12,241	387	Counting Tower
1994	11,877	479	Counting Tower
1995	11,394	1,210	Mark-Recapture
1996	7,153	913	Mark-Recapture
1997	10,810	1,189	Mark-Recapture
1998	4,745	503	Counting Tower
1999	6,485	427	Counting Tower
2000	4,694	1,184	Mark-Recapture
2001	9,696	565	Counting Tower
2002	6,967	2,466	Mark-Recapture
2003	11,100[a]	653	Counting Tower
2004	9,645	532	Counting Tower
2005[b]	-[b]	-	-
2006	2,936	163	Counting Tower
2007	3,806	226	Counting Tower
2008	3,208	198	Counting Tower
2009	5,253	231	Counting Tower

[a] Estimate includes an expansion for missed counting days. SE is a minimum estimate and does not include uncertainty associated with expansion for missed days.

[b] Escapement was not estimated due to multiple flood events.

Table 3.–Daily estimates of Chena River Chinook salmon escapement, 2007. Shaded cells indicate days estimated using the moving average estimator due to water clarity conditions.

Date	Day of Run	Number of 10 Min. Counts[a]	Number Counted	Daily Escapement	SE
28-Jun	0	16	0	0	0.0
29-Jun	0	48	0	0	0.0
30-Jun	0	48	0	0	0.0
1-Jul	0	48	0	0	0.0
2-Jul	1	48	1	6	4.1
3-Jul	2	48	0	0	11.7
4-Jul	3	48	0	0	0.0
5-Jul	4	48	1	6	5.9
6-Jul	5	48	6	36	16.6
7-Jul	6	48	13	78	23.4
8-Jul	7	48	13	78	37.0
9-Jul	8	48	20	120	46.1
10-Jul	9	48	12	72	13.1
11-Jul	10	44	17	122	36.7
12-Jul	11	48	8	48	25.2
13-Jul	12	44	28	192	30.0
14-Jul	13	48	29	174	32.3
15-Jul	14	48	36	216	39.9
16-Jul	15	48	31	186	54.8
17-Jul	16	48	63	378	83.6
18-Jul	17	48	53	318	69.4
19-Jul	18	48	29	174	35.1
20-Jul	19	48	61	366	91.0
21-Jul	20	48	35	210	36.3
22-Jul	21	48	26	156	45.2
23-Jul	22	48	18	108	36.3
24-Jul	23	38	18	162	42.8
25-Jul	24	0	0	137	59.1
26-Jul	25	0	0	120	54.8
27-Jul	26	41	16	114	35.6
28-Jul	27	47	15	91	22.4
29-Jul	28	48	12	72	25.2
30-Jul	29	48	5	30	16.6
31-Jul	30	48	3	18	24.5
1-Aug	31	48	1	6	8.3
2-Aug	32	48	3	18	13.1
3-Aug	33	48	-2	-12	8.3
4-Aug	34	48	1	6	5.9
Total	-	-	573	3,806	226.0

[a] A total of 48 counts equals a full day of counts on each side of the river.

Table 4.–Daily estimates of Chena River chum salmon escapement, 2007. Shaded cells indicate days estimated using the moving average estimator due to water clarity conditions.

Date	Day of Run	Number of 10 Min. Counts[a]	Number Counted	Daily Escapement	SE
28-Jun	0	16	0	0	0.0
29-Jun	0	48	0	0	0.0
30-Jun	0	48	0	0	0.0
1-Jul	0	48	0	0	0.0
2-Jul	1	48	1	6	4.1
3-Jul	2	48	2	12	11.7
4-Jul	3	48	4	24	13.7
5-Jul	4	48	0	0	0.0
6-Jul	5	48	0	0	0.0
7-Jul	6	48	0	0	0.0
8-Jul	7	48	2	12	7.2
9-Jul	8	48	4	24	17.6
10-Jul	9	48	1	6	5.9
11-Jul	10	48	3	18	12.4
12-Jul	11	48	2	12	8.3
13-Jul	12	44	6	36	21.9
14-Jul	13	48	1	6	19.0
15-Jul	14	48	4	24	10.1
16-Jul	15	48	9	54	24.8
17-Jul	16	48	20	120	41.8
18-Jul	17	48	19	114	44.4
19-Jul	18	48	14	84	54.5
20-Jul	19	48	35	210	64.4
21-Jul	20	48	30	180	63.6
22-Jul	21	48	14	84	37.9
23-Jul	22	48	17	102	23.8
24-Jul	23	38	2	18	14.5
25-Jul	24	0	0	130	74.0
26-Jul	25	0	0	246	136.7
27-Jul	26	40	38	270	84.1
28-Jul	27	47	75	453	94.0
29-Jul	28	48	22	132	39.7
30-Jul	29	48	29	174	68.5
31-Jul	30	48	62	372	79.0
1-Aug	31	48	102	612	146.9
2-Aug	32	48	77	462	114.7
3-Aug	33	48	94	564	127.6
4-Aug	34	48	73	438	90.0
Total	-	-	763	4,999	362.0

[a] A total of 48 counts equals a full day of counts on each side of the river.

In 2008, the counting tower was in operation from 30 June through 28 July. A few days of rain resulted in less than favorable viewing conditions on 3, 22, and 23 July, which led to no counts for those 3 days (Table 5). Heavy rains at the end of July caused the river to reach flood stage and the counting panels were removed from the water on 29 July. Even though tower counts were terminated when some Chinook salmon were still migrating upstream, the estimate was considered a total escapement estimate because the average proportion of the run, since 1997, that passed the counting tower after 29 July was 0.04. The estimated escapement of Chinook salmon was 3,208 (SE=198), which was within the established BEG (Table 3, Figure 3). The estimated chum salmon escapement was 1,300 (SE=106), which was considered a minimum estimate because tower counts were terminated before the chum run was completed (Table 6).

Table 5.–Daily estimates of Chena River Chinook salmon escapement, 2008. Shaded cells indicate days estimated using the moving average estimator due to water clarity conditions.

Date	Day of Run	Number of 10 or 20 Min. Counts[a]	Number Counted	Daily Escapement	Daily SE
30-Jun	1	39	0	0	0.0
1-Jul	2	48	0	0	0.0
2-Jul	3	33	0	0	0.0
3-Jul	4	16	0	0	0.0
4-Jul	5	33	0	0	0.0
5-Jul	6	41	0	0	0.0
6-Jul	7	48	2	12	11.7
7-Jul	8	48	1	6	5.9
8-Jul	9	48	3	18	10.1
9-Jul	10	48	0	0	0.0
10-Jul	11	24	1	3	1.9
11-Jul	12	24	3	9	5.6
12-Jul	13	24	29	87	37.3
13-Jul	14	24	19	57	20.9
14-Jul	15	24	4	12	5.2
15-Jul	16	23	5	15	10.9
16-Jul	17	24	3	9	4.1
17-Jul	18	24	4	12	25.9
18-Jul	19	24	4	12	6.4
19-Jul	20	24	0	0	0.0
20-Jul	21	24	34	102	43.7
21-Jul	22	18	18	54	16.2
22-Jul	23	0	0	60	34.0
23-Jul	24	0	0	60	34.0
24-Jul	25	16	5	23	15.3
25-Jul	26	24	34	102	16.0
26-Jul	27	23	63	195	30.5
27-Jul	28	24	64	192	28.7
28-Jul	29	23	85	260	38.4
Total	-	-	381	1,300	-

[a] On 10 July the methods were changed to count the whole river for 20 minutes of each hour instead of each half of the river for 10 minutes of each hour.

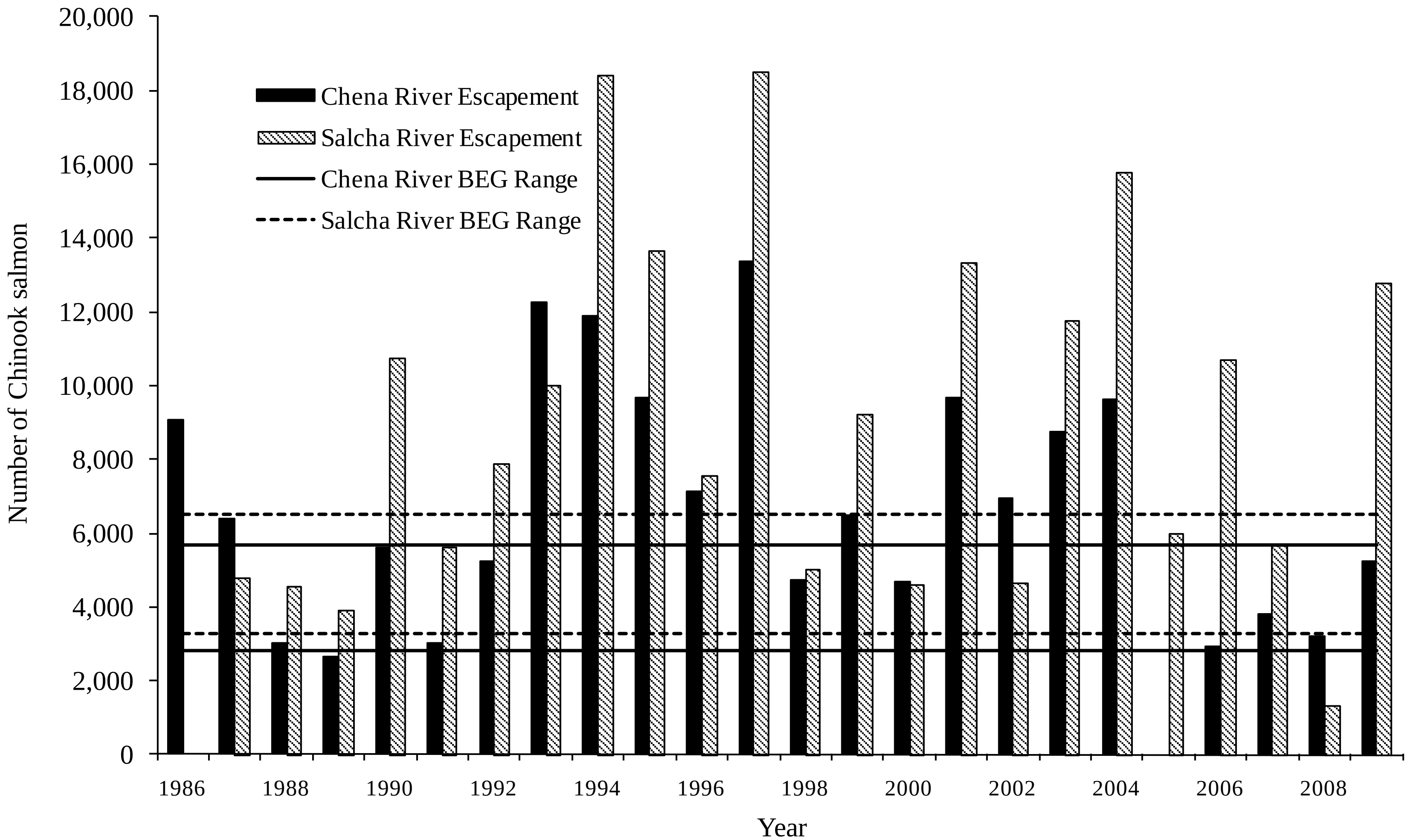

Figure 3.–Estimates of Chinook salmon escapements to the Chena and Salcha rivers and their respective BEG’s, 1986–2009.

Table 6.–Daily estimates of Chena River chum salmon escapement, 2008. Shaded cells indicate days estimated using the moving average estimator due to water clarity conditions.

Date	Day of Run	Number of 10 or 20 Min. Counts[a]	Number Counted	Daily Escapement	Daily SE
30-Jun	1	39	0	0	0.0
1-Jul	2	48	0	0	0.0
2-Jul	3	33	0	0	0.0
3-Jul	4	16	0	0	0.0
4-Jul	5	33	0	0	0.0
5-Jul	6	41	0	0	0.0
6-Jul	7	48	2	12	11.7
7-Jul	8	48	1	6	5.9
8-Jul	9	48	3	18	10.1
9-Jul	10	48	0	0	0.0
10-Jul	11	24	1	3	1.9
11-Jul	12	24	3	9	5.6
12-Jul	13	24	29	87	37.3
13-Jul	14	24	19	57	20.9
14-Jul	15	24	4	12	5.2
15-Jul	16	23	5	15	10.9
16-Jul	17	24	3	9	4.1
17-Jul	18	24	4	12	25.9
18-Jul	19	24	4	12	6.4
19-Jul	20	24	0	0	0.0
20-Jul	21	24	34	102	43.7
21-Jul	22	18	18	54	16.2
22-Jul	23	0	0	60	34.0
23-Jul	24	0	0	60	34.0
24-Jul	25	16	5	23	15.3
25-Jul	26	24	34	102	16.0
26-Jul	27	23	63	195	30.5
27-Jul	28	24	64	192	28.7
28-Jul	29	23	85	260	38.4
Total	-	-	381	1,300	106

[a] On 10 July the methods were changed to count the whole river for 20 minutes of each hour instead of each half of the river for 10 minutes of each hour.

In 2009, the counting tower was in operation from 5 July through 8 August. A few days of rain resulted in less than favorable viewing conditions during the last few days of June and early July when counts typically begin; however, when conditions improved a full day was counted before any salmon were observed migrating upstream (Table 7). Even though tower counts began after some Chinook salmon may have migrated upstream, the estimate is considered a total escapement estimate because the average proportion of the run, since 1997, that passed the counting tower before 5 July was 0.03. The estimated escapement of Chinook salmon was 5,253 (SE=231), which was within the established BEG (Table 3, Figure 3). The estimated chum salmon escapement was 16,516 (SE=643), which was considered a minimum estimate because tower counts were terminated before the chum run was completed (Table 8).

Run Timing

Run timing patterns past the counting tower (Figure 4) were described by the day of the run to facilitate comparison among years (i.e., Day 1 equals the first Chinook salmon passing upriver during a scheduled count). The patterns observed during 2007–2009 were earlier than the average over all years when the entire escapement was enumerated.

Age, Sex, and Length Composition

In 2007, carcass surveys began on 3 August and ended prematurely on 7 August due to high water conditions. Heavy rains on 4–6 August caused the river to rise to levels where carcasses were not visible because of water clarity and/or were not available because they had drifted off the gravel bars. A total of 89 Chinook salmon carcasses were sampled for ASL data.

The sex composition of the escapement was 0.39 (SE=0.05) females and 0.61 (SE=0.05) for males (Table 9). The sex composition adjusted for gender bias was 0.27 (SE=0.05) females and 0.73 (SE=0.09) for males. The age and length composition of the escapement was determined for each sex (Table 10). The dominant age class was age 5 for males and females.

In 2008, carcass surveys began on 4 August and ended on 15 August due to high water conditions. Heavy rains at the end of July through the first week of August caused the river to rise to levels where carcasses were not visible because of water clarity and/or were not available because they had drifted off the gravel bars. A total of 44 Chinook salmon carcasses were sampled for ASL data; this sample size was not enough to meet the desired level of precision but estimates were still calculated.

The sex composition of the escapement was 0.41 (SE=0.08) females and 0.59 (SE=0.08) for males (Table 9). The sex composition adjusted for gender bias was 0.29 (SE=0.06) females and 0.71 (SE=0.10) for males. The age and length composition of the escapement was determined for each sex (Table 11). The dominant age class for males was age 5, and the dominant age classes for females were ages-5 and 6.

In 2009, carcass surveys began on 3 August and ended on 13 August. A total of 482 Chinook salmon carcasses were sampled for ASL data.

The sex composition of the escapement was 0.57 (SE=0.02) females and 0.43 (SE=0.02) for males (Table 9). The sex composition adjusted for gender bias was 0.40 (SE=0.08) females and 0.60 (SE=0.06) for males. The age and length composition of the escapement was determined for each sex (Table 12). The dominant age class was age 6 for males and females.

Age composition (adjusted and unadjusted) and escapement estimates by gender and for all fish were variable over time but no significant changes were observed (Table 13).

DELTA CLEARWATER RIVER COHO SALMON

In 2007, the boat survey was conducted from 31 October to 1 November and the minimum estimate of escapement was 14,650. In 2008, the boat survey was conducted on 30 October and the minimum estimate of escapement was 7,500. In 2009, the boat survey was conducted on 26 October and the minimum estimate of escapement was 16,850 (Table 14).

Table 7.–Daily estimates of Chena River Chinook salmon escapement, 2009.

Date	Day of Run	Number of 20 Min. Counts	Number Counted	Daily Escapement	Daily SE
5-Jul	1	16	0	0	0.0
6-Jul	2	24	10	30	14.0
7-Jul	3	24	16	48	12.0
8-Jul	4	24	28	84	28.0
9-Jul	5	24	35	105	11.7
10-Jul	6	24	23	69	24.0
11-Jul	7	24	55	165	38.8
12-Jul	8	24	88	264	41.7
13-Jul	9	24	102	306	46.8
14-Jul	10	24	86	258	40.6
15-Jul	11	24	160	480	59.2
16-Jul	12	24	79	237	39.1
17-Jul	13	24	54	162	21.2
18-Jul	14	24	98	294	39.5
19-Jul	15	23	140	474	126.0
20-Jul	16	24	146	438	87.9
21-Jul	17	24	89	267	51.6
22-Jul	18	23	130	411	65.0
23-Jul	19	24	86	258	31.0
24-Jul	20	24	47	141	28.3
25-Jul	21	24	25	75	21.8
26-Jul	22	24	77	231	51.0
27-Jul	23	24	51	153	23.9
28-Jul	24	24	45	135	24.6
29-Jul	25	24	13	39	16.2
30-Jul	26	24	13	39	9.8
31-Jul	27	24	13	39	9.1
1-Aug	28	24	7	21	10.0
2-Aug	29	24	6	18	11.6
3-Aug	30	24	8	24	6.7
4-Aug	31	24	-3	-9	4.1
5-Aug	32	24	-1	-3	5.9
6-Aug	33	24	1	3	3.7
7-Aug	34	24	-1	-3	4.5
8-Aug	35	16	0	0	0.0
Total	-	-	1,726	5,253	-

Table 8.–Daily estimates of Chena River chum salmon escapement, 2009.

Date	Day of Run	Number of 20 Min. Counts	Number Counted	Daily Escapement	Daily SE
5-Jul	1	16	0	0	0.0
6-Jul	2	24	0	6	3.2
7-Jul	3	24	0	21	18.3
8-Jul	4	24	0	9	5.6
9-Jul	5	24	0	9	5.6
10-Jul	6	24	0	9	5.9
11-Jul	7	24	0	0	0.0
12-Jul	8	24	0	3	2.6
13-Jul	9	24	0	30	10.0
14-Jul	10	24	0	36	10.3
15-Jul	11	24	0	81	12.6
16-Jul	12	24	0	63	13.9
17-Jul	13	24	0	120	43.0
18-Jul	14	24	18	39	11.6
19-Jul	15	23	24	194	44.1
20-Jul	16	24	66	153	36.9
21-Jul	17	24	48	144	49.6
22-Jul	18	23	33	365	75.8
23-Jul	19	24	27	312	81.6
24-Jul	20	24	137	297	64.5
25-Jul	21	24	105	537	92.3
26-Jul	22	24	75	837	95.0
27-Jul	23	24	177	1185	174.7
28-Jul	24	24	264	2268	272.5
29-Jul	25	24	228	1053	190.6
30-Jul	26	24	303	1242	196.6
31-Jul	27	24	327	1428	251.7
1-Aug	28	24	360	555	92.7
2-Aug	29	24	972	576	141.2
3-Aug	30	24	528	936	188.6
4-Aug	31	24	483	1293	145.7
5-Aug	32	24	951	789	108.4
6-Aug	33	24	141	816	131.0
7-Aug	34	24	480	741	93.1
8-Aug	35	16	498	369	68.5
Total	-	-	6,245	16,516	643

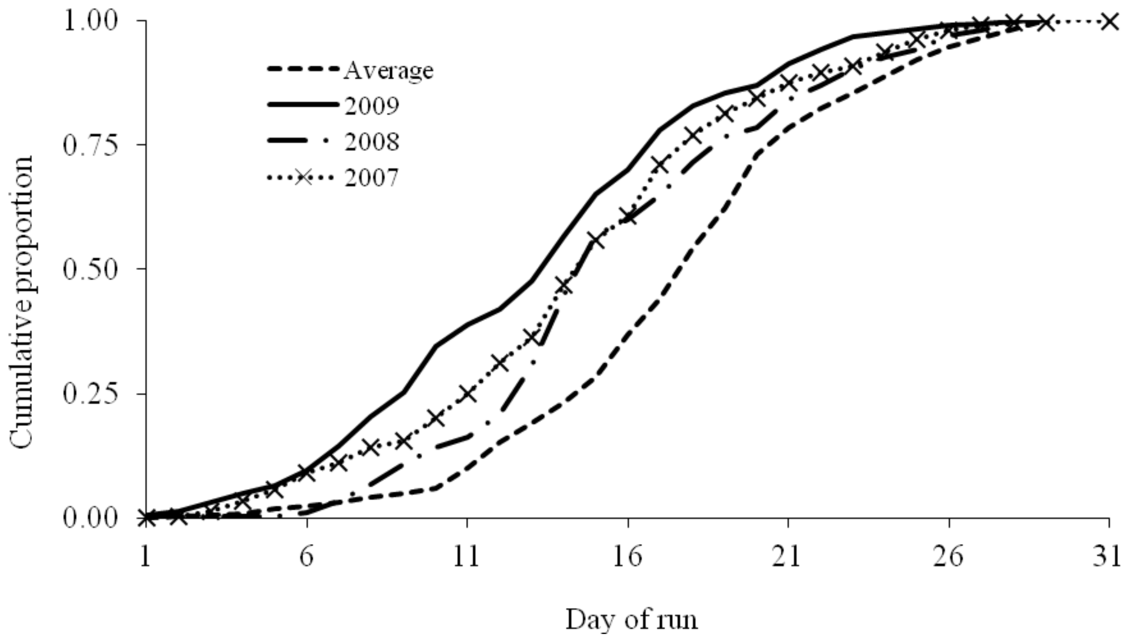

Figure 4.–Run timing pattern for Chena River Chinook salmon past the counting tower in 2007, 2008, and 2009 compared to the 1997–1999, 2003–2004, and 2006 average.

Table 9.–Proportions of male and female Chinook salmon sampled from carcass surveys on the Chena River, 1986–2009.

	Sexed Sample Size		Sexed Sample Proportion		Sexed and Aged Sample Size		Sexed and Aged Sample Proportion		Adjusted Proportion		Total	
Year	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Escapement	Method
1986	987	365	0.73	0.27	538	183	0.75	0.25	0.75	0.25	9,065	MR
1987	438	592	0.43	0.57	235	325	0.42	0.58	0.52	0.48	6,404	MR
1988	347	543	0.39	0.61	183	285	0.39	0.61	0.66	0.34	3,346	MR
1989	119	218	0.35	0.65	101	187	0.35	0.65	0.55	0.45	2,730	MR
1990	412	376	0.52	0.48	291	258	0.53	0.47	0.64	0.36	5,603	MR
1991	684	315	0.68	0.32	231	108	0.68	0.32	0.68	0.32	3,172	MR
1992	368	210	0.64	0.36	289	176	0.62	0.38	0.78	0.22	5,580	MR
1993	205	38	0.84	0.16	156	31	0.83	0.17	0.88	0.12	12,241	CT
1994	326	275	0.54	0.46	281	231	0.55	0.45	0.68	0.32	11,877	CT
1995	305	593	0.34	0.66	267	520	0.34	0.66	0.48	0.52	11,394	MR
1996	346	268	0.56	0.44	286	229	0.56	0.44	0.73	0.27	7,153	MR
1997	524	354	0.60	0.40	424	278	0.60	0.40	0.74	0.26	10,810	MR
1998	160	107	0.60	0.40	134	94	0.59	0.41	0.72	0.28	4,745	CT
1999	74	134	0.36	0.64	61	116	0.34	0.66	0.54	0.46	6,485	CT
2000	113	56	0.67	0.33	99	50	0.66	0.34	0.78	0.22	4,694	MR
2001	342	253	0.57	0.43	292	229	0.56	0.44	0.70	0.30	9,696	CT
2002	277	216	0.56	0.44	207	167	0.55	0.45	0.73	0.27	6,967	MR
2003	253	206	0.55	0.45	204	166	0.55	0.45	0.68	0.32	11,100[d]	CT
2004	98	160	0.38	0.62	88	151	0.37	0.63	0.56	0.44	9,645	CT
2005	352	268	0.57	0.43	319	234	0.58	0.42	0.69	0.31	-[e]	-
2006	221	183	0.55	0.45	196	166	0.54	0.46	0.68	0.32	2,936	CT
2007	52	31	0.63	0.37	37	25	0.60	0.40	0.74	0.26	3,806	CT
2008	26	18	0.59	0.41	20	16	0.56	0.44	0.71	0.29	3,208	CT
2009	209	272	0.43	0.57	198	244	0.45	0.55	0.60	0.40	5,253	CT
Average	302	252	0.55	0.45	214	186	0.54	0.46	0.68	0.32	6,749	

[a] Estimated proportions were all derived from carcass samples.

[b] In years when counting tower assessments (CT) were conducted and only carcass surveys were conducted, proportions of males and females were adjusted using the methods shown in Appendix A. In years when mark-recapture experiments (MR) were conducted, proportions of males and females were estimated as the ratio of the abundance estimate of each gender to the abundance estimate of all fish.

[c] Escapement estimates were obtained from either a counting tower (CT) assessment or mark-recapture (MR) project.

[d] Estimate includes an expansion for missed counting days.

[e] Escapement was not estimated due to multiple flood events.

Table 10.–Estimated proportions and mean length by age and sex of Chinook salmon sampled during the Chena River carcass survey, 2007.

	Sample	Sample	Length			
Age[a]	Size	Proportion	Mean	SE	Min	Max
Male						
1.1	2	0.05	388	8	380	395
1.2	4	0.35	513	11	450	605
1.3	13	0.30	634	27	530	830
1.4	11	0.30	749	27	635	950
Total Aged	37					
Total Males[b]	52	0.63				
Adjusted Total[c]	-	0.74				
Female						
1.2	4	0.16	565	22	535	630
1.3	11	0.44	797	20	690	900
1.4	10	0.40	816	19	725	955
Total Aged	25					
Total Females[b]	31	0.37				
Adjusted Total[c]	-	0.26				

[a] Age is represented by the number of annuli formed during river residence and ocean residence (i.e., an age of 1.4 represents one annulus formed during river residence and four annuli formed during ocean residence plus one year for year of spawning for a total age of 6 years).

[b] Totals include those Chinook salmon which could not be aged.

[c] Estimated proportion of females was corrected by a factor of 0.708.

Table 11.–Estimated proportions and mean length by age and sex of Chinook salmon sampled during the Chena River carcass survey, 2008.

Age[a]	Sample Size	Sample Proportion	Length Mean	SE	Min	Max
Male						
1.2	3	0.15	593	34	530	645
1.3	15	0.75	719	10	655	790
1.4	2	0.10	873	118	755	990
Total Aged	20					
Total Males[b]	26	0.59				
Adjusted Total[c]	-	0.71				
Female						
1.3	7	0.44	814	15	740	850
1.4	7	0.44	866	13	810	920
1.5	2	0.12	920	0	920	920
Total Aged	16					
Total Females[b]	18	0.41				
Adjusted Total[c]	-	0.29				

[a] Age is represented by the number of annuli formed during river residence and ocean residence (i.e., an age of 1.4 represents one annulus formed during river residence and four annuli formed during ocean residence plus one year for year of spawning for a total age of 6 years).

[b] Totals include those Chinook salmon which could not be aged.

[c] Estimated proportion of females was corrected by a factor of 0.708.

Table 12.–Estimated proportions and mean length by age and sex of Chinook salmon sampled during the Chena River carcass survey, 2009.

	Sample	Sample	Length			
Age[a]	Size	Proportion	Mean	SE	Min	Max
Male						
1.2	62	0.31	598	7	470	780
1.3	58	0.29	710	8	510	910
1.4	78	0.39	850	9	620	1,040
Total Aged	198					
Total Males[b]	208	0.43				
Adjusted Total[c]	-	0.60				
Female						
1.2	2	0.01	593	23	570	615
1.3	17	0.07	783	14	650	850
1.4	222	0.91	841	5	740	995
1.5	3	0.01	890	36	840	960
Total Aged	244					
Total Females[b]	272	0.57				
Adjusted Total[c]	-	0.40				

[a] Age is represented by the number of annuli formed during river residence and ocean residence (i.e., an age of 1.4 represents one annulus formed during river residence and four annuli formed during ocean residence plus one year for year of spawning for a total age of 6 years).

[b] Totals include those Chinook salmon which could not be aged.

[c] Estimated proportion of females was corrected by a factor of 0.708.

Table 13.–Age composition and escapement estimates by gender and by all fish combined (unadjusted and adjusted) of Chena River Chinook salmon, 1986–2009.

Males	Total Age (years)/European Age (freshwater years/ocean years)										Male	Male
	3	4	5		6		7		8		Unadjusted[a]	Adjusted[b]
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Escapement	Escapement
1986	0.002	0.126	0.636	0.000	0.197	0.019	0.020	0.000	0.000	0.000	6,618	6,764
1987	0.000	0.064	0.281	0.000	0.613	0.009	0.034	0.000	0.000	0.000	2,723	3,320
1988	0.016	0.268	0.355	0.000	0.279	0.000	0.082	0.000	0.000	0.000	1,305	2,212
1989	0.010	0.109	0.495	0.020	0.347	0.010	0.010	0.000	0.000	0.000	964	1,492
1990	0.000	0.423	0.309	0.003	0.254	0.000	0.010	0.000	0.000	0.000	2,929	3,569
1991	0.000	0.126	0.489	0.000	0.312	0.000	0.074	0.000	0.000	0.000	2,172	2,172
1992	0.031	0.682	0.208	0.000	0.080	0.000	0.000	0.000	0.000	0.000	3,553	4,373
1993	0.006	0.353	0.442	0.000	0.192	0.000	0.006	0.000	0.000	0.000	10,327	10,804
1994	0.000	0.053	0.644	0.000	0.292	0.004	0.007	0.000	0.000	0.000	6,442	8,029
1995	0.000	0.131	0.360	0.000	0.491	0.000	0.015	0.004	0.000	0.000	3,870	5,509
1996	0.038	0.108	0.629	0.000	0.136	0.000	0.087	0.000	0.000	0.000	4,031	5,239
1997	0.005	0.611	0.184	0.000	0.196	0.000	0.002	0.002	0.000	0.000	6,452	8,038
1998	0.000	0.075	0.858	0.000	0.045	0.000	0.022	0.000	0.000	0.000	2,843	3,399
1999	0.000	0.115	0.377	0.000	0.508	0.000	0.000	0.000	0.000	0.000	2,307	3,527
2000	0.004	0.386	0.458	0.000	0.149	0.000	0.004	0.000	0.000	0.000	3,139	3,675
2001	0.010	0.154	0.462	0.000	0.353	0.000	0.021	0.000	0.000	0.000	5,573	6,777
2002	0.002	0.422	0.364	0.000	0.206	0.000	0.005	0.000	0.000	0.000	3,915	5,063
2003	0.000	0.088	0.623	0.000	0.240	0.000	0.049	0.000	0.000	0.000	6,118	7,573
2004	0.000	0.295	0.318	0.000	0.364	0.000	0.023	0.000	0.000	0.000	3,664	5,410
2005	0.000	0.110	0.571	0.000	0.292	0.000	0.016	0.013	0.000	0.000	-[e]	-[e]
2006	0.000	0.235	0.592	0.005	0.148	0.005	0.015	0.000	0.000	0.000	1,606	1,994
2007	0.054	0.351	0.297	0.000	0.297	0.000	0.000	0.000	0.000	0.000	2,384	2,800
2008	0.000	0.150	0.750	0.000	0.100	0.000	0.000	0.000	0.000	0.000	1,896	2,279
2009	0.000	0.313	0.293	0.000	0.394	0.000	0.000	0.000	0.000	0.000	2,282	3,150
Average	0.007	0.239	0.458	0.001	0.270	0.002	0.021	0.001	0.000	0.000	3,726	4,583

-continued-

Table 13.–Page 2 of 4.

Females	Total Age (years)/European Age (freshwater years/ocean years)										Female	Female
	3	4	5		6		7		8		Unadjusted[a]	Adjusted[b]
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Escapement	Escapement
1986	0.000	0.000	0.131	0.000	0.546	0.000	0.311	0.005	0.000	0.005	2,447	2,301
1987	0.000	0.003	0.022	0.000	0.855	0.000	0.114	0.006	0.000	0.000	3,681	3,084
1988	0.000	0.000	0.060	0.000	0.582	0.000	0.351	0.000	0.000	0.007	2,041	1,134
1989	0.000	0.005	0.187	0.000	0.652	0.000	0.155	0.000	0.000	0.000	1,766	1,238
1990	0.000	0.008	0.194	0.000	0.733	0.000	0.066	0.000	0.000	0.000	2,674	2,034
1991	0.000	0.000	0.120	0.000	0.620	0.000	0.231	0.009	0.009	0.009	1,000	1,000
1992	0.000	0.000	0.284	0.000	0.710	0.000	0.006	0.000	0.000	0.000	2,027	1,207
1993	0.000	0.000	0.258	0.000	0.710	0.000	0.032	0.000	0.000	0.000	1,914	1,437
1994	0.000	0.000	0.182	0.000	0.771	0.004	0.043	0.000	0.000	0.000	5,435	3,848
1995	0.000	0.000	0.131	0.000	0.821	0.000	0.044	0.004	0.000	0.000	7,524	5,885
1996	0.000	0.004	0.210	0.000	0.358	0.000	0.428	0.000	0.000	0.000	3,122	1,914
1997	0.000	0.007	0.058	0.000	0.914	0.000	0.022	0.000	0.000	0.000	4,358	2,772
1998	0.000	0.000	0.532	0.000	0.383	0.000	0.085	0.000	0.000	0.000	1,902	1,346
1999	0.000	0.009	0.181	0.000	0.810	0.000	0.000	0.000	0.000	0.000	4,178	2,958
2000	0.000	0.000	0.145	0.000	0.768	0.000	0.087	0.000	0.000	0.000	1,555	1,019
2001	0.000	0.022	0.175	0.000	0.716	0.000	0.087	0.000	0.000	0.000	4,123	2,919
2002	0.000	0.000	0.137	0.000	0.802	0.000	0.061	0.000	0.000	0.000	3,052	1,904
2003	0.000	0.006	0.271	0.000	0.633	0.000	0.090	0.000	0.000	0.000	4,982	3,527
2004	0.000	0.000	0.086	0.000	0.881	0.000	0.033	0.000	0.000	0.000	5,981	4,235
2005	0.000	0.004	0.402	0.000	0.530	0.004	0.043	0.017	0.000	0.000	-[e]	-[e]
2006	0.000	0.000	0.289	0.000	0.705	0.000	0.006	0.000	0.000	0.000	1,330	942
2007	0.000	0.160	0.440	0.000	0.400	0.000	0.000	0.000	0.000	0.000	1,422	1,006
2008	0.000	0.000	0.438	0.000	0.438	0.000	0.125	0.000	0.000	0.000	1,312	929
2009	0.000	0.008	0.070	0.000	0.910	0.000	0.012	0.000	0.000	0.000	2,971	2,103
Average	0.000	0.010	0.208	0.000	0.677	0.000	0.101	0.002	0.000	0.001	3,023	2,166

-continued-

Table 13.–Page 3 of 4.

Unadjusted[a]	Total Age (years)/European Age (freshwater years/ocean years)											
All Fish	3	4	5		6		7		8		Total	
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Escapement	Method[c]
1986	0.001	0.094	0.508	0.000	0.286	0.014	0.094	0.001	0.000	0.001	9,065	MR
1987	0.000	0.029	0.130	0.000	0.754	0.004	0.080	0.004	0.000	0.000	6,404	MR
1988	0.006	0.105	0.175	0.000	0.464	0.000	0.246	0.000	0.000	0.004	3,346	MR
1989	0.003	0.042	0.295	0.007	0.545	0.003	0.104	0.000	0.000	0.000	2,730	MR
1990	0.000	0.228	0.255	0.002	0.479	0.000	0.036	0.000	0.000	0.000	5,603	MR
1991	0.000	0.086	0.372	0.000	0.410	0.000	0.124	0.003	0.003	0.003	3,172	MR
1992	0.019	0.424	0.234	0.002	0.316	0.002	0.002	0.000	0.000	0.000	5,580	MR
1993	0.005	0.294	0.412	0.000	0.278	0.000	0.011	0.000	0.000	0.000	12,241	CT
1994	0.000	0.029	0.436	0.000	0.508	0.004	0.023	0.000	0.000	0.000	11,877	CT
1995	0.000	0.044	0.208	0.000	0.709	0.000	0.034	0.004	0.000	0.000	11,394	MR
1996	0.021	0.062	0.443	0.000	0.235	0.000	0.239	0.000	0.000	0.000	7,153	MR
1997	0.003	0.372	0.134	0.000	0.480	0.000	0.010	0.001	0.000	0.000	10,810	MR
1998	0.000	0.044	0.724	0.000	0.184	0.000	0.048	0.000	0.000	0.000	4,745	CT
1999	0.000	0.045	0.249	0.000	0.706	0.000	0.000	0.000	0.000	0.000	6,485	CT
2000	0.000	0.201	0.356	0.000	0.356	0.000	0.087	0.000	0.000	0.000	4,694	MR
2001	0.006	0.096	0.336	0.000	0.512	0.000	0.050	0.000	0.000	0.000	9,696	CT
2002	0.000	0.238	0.278	0.000	0.444	0.000	0.040	0.000	0.000	0.000	6,967	MR
2003	0.000	0.051	0.465	0.000	0.416	0.000	0.068	0.000	0.000	0.000	11,100[d]	CT
2004	0.000	0.109	0.172	0.000	0.690	0.000	0.029	0.000	0.000	0.000	9,645	CT
2005	0.000	0.065	0.499	0.000	0.392	0.002	0.027	0.014	0.000	0.000	-[e]	-
2006	0.000	0.127	0.453	0.003	0.403	0.003	0.011	0.000	0.000	0.000	2,936	CT
2007	0.032	0.274	0.355	0.000	0.339	0.000	0.000	0.000	0.000	0.000	3,806	CT
2008	0.000	0.083	0.611	0.000	0.250	0.000	0.056	0.000	0.000	0.000	3,208	CT
2009	0.000	0.145	0.170	0.000	0.679	0.000	0.007	0.000	0.000	0.000	5,253	CT
Average	0.004	0.137	0.344	0.001	0.451	0.001	0.059	0.001	0.000	0.000	6,749	

-continued-

Table 13.–Page 4 of 4.

Adjusted[b]	Total Age (years)/European Age (freshwater years/ocean years)											
All Fish	3	4	5		6		7		8		Total	
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Escapement	Method[c]
1986	0.001	0.094	0.508	0.000	0.286	0.014	0.094	0.001	0.000	0.001	9,065	MR
1987	0.000	0.035	0.156	0.000	0.730	0.004	0.072	0.003	0.000	0.000	6,404	MR
1988	0.011	0.177	0.255	0.000	0.382	0.000	0.173	0.000	0.000	0.002	3,346	MR
1989	0.005	0.062	0.355	0.011	0.485	0.005	0.076	0.000	0.000	0.000	2,730	MR
1990	0.000	0.272	0.267	0.002	0.428	0.000	0.030	0.000	0.000	0.000	5,603	MR
1991	0.000	0.086	0.373	0.000	0.409	0.000	0.123	0.003	0.003	0.003	3,172	MR
1992	0.027	0.574	0.194	0.000	0.204	0.000	0.001	0.000	0.000	0.000	5,580	MR
1993	0.006	0.311	0.421	0.000	0.253	0.000	0.009	0.000	0.000	0.000	12,241	CT
1994	0.000	0.036	0.494	0.000	0.447	0.004	0.019	0.000	0.000	0.000	11,877	CT
1995	0.000	0.063	0.241	0.000	0.661	0.000	0.030	0.004	0.000	0.000	11,394	MR
1996	0.028	0.081	0.517	0.000	0.196	0.000	0.179	0.000	0.000	0.000	7,153	MR
1997	0.004	0.456	0.152	0.000	0.380	0.000	0.007	0.002	0.000	0.000	10,810	MR
1998	0.000	0.053	0.766	0.000	0.141	0.000	0.040	0.000	0.000	0.000	4,745	CT
1999	0.000	0.066	0.288	0.000	0.646	0.000	0.000	0.000	0.000	0.000	6,485	CT
2000	0.003	0.302	0.390	0.000	0.283	0.000	0.022	0.000	0.000	0.000	4,694	MR
2001	0.007	0.114	0.376	0.000	0.462	0.000	0.041	0.000	0.000	0.000	9,696	CT
2002	0.002	0.307	0.302	0.000	0.369	0.000	0.020	0.000	0.000	0.000	6,967	MR
2003	0.000	0.062	0.511	0.000	0.365	0.000	0.062	0.000	0.000	0.000	11,100[d]	CT
2004	0.000	0.166	0.216	0.000	0.591	0.000	0.027	0.000	0.000	0.000	9,645	CT
2005	0.000	0.077	0.519	0.000	0.364	0.001	0.024	0.014	0.000	0.000	-[e]	-
2006	0.000	0.159	0.495	0.003	0.327	0.003	0.012	0.000	0.000	0.000	2,936	CT
2007	0.040	0.301	0.335	0.000	0.324	0.000	0.000	0.000	0.000	0.000	3,806	CT
2008	0.000	0.107	0.659	0.000	0.198	0.000	0.036	0.000	0.000	0.000	3,208	CT
2009	0.000	0.191	0.204	0.000	0.600	0.000	0.005	0.000	0.000	0.000	5,253	CT
Average	0.006	0.173	0.375	0.001	0.397	0.001	0.046	0.001	0.000	0.000	6,749	

[a] Unadjusted escapement and composition estimates were derived from the observed sample proportions of males and females from carcass surveys.

[b] Adjusted escapement and composition estimates were derived either from mark-recapture estimates (MR) or in years when counting tower (CT) assessments were conducted, from carcass surveys that were adjusted using the methods described in Appendix A and do not necessarily reflect actual sample proportions.

[c] Escapement estimates were obtained from either a counting tower (CT) assessment or mark-recapture (MR) project.

[d] Estimate includes an expansion for missed counting days. CV is a minimum estimate and does not include uncertainty associated with expansion for missed days.

[e] Escapement was not estimated due to multiple flood events.

Table 14.–Minimum estimates of escapement for Delta Clearwater coho salmon, 1980–2009.

Year	Survey Date	Minimum Escapement
1980	28 Oct	3,946
1981	21 Oct	8,563
1982	3 Nov	8,365
1983	25 Oct	8,019
1984	6 Nov	11,061
1985	13 Nov	6,842
1986	21 Oct	10,857
1987	27 Oct	22,300
1988	28 Oct	21,600
1989	25 Oct	12,600
1990	26 Oct	8,325
1991	23 Oct	23,900
1992	26 Oct	3,963
1993	21 Oct	10,875
1994	24 Oct	62,675
1995	23 Oct	20,100
1996	29 Oct	14,075
1997	24 Oct	11,525
1998	20 Oct	11,100
1999	28 Oct	10,975
2000	24 Oct	9,225
2001	19 Oct	46,875
2002	31 Oct	38,625
2003	21 Oct	105,850
2004	27 Oct	37,950
2005	25 Oct	34,293
2006	24 Oct	16,748
2007	31 Oct-1 Nov	14,650
2008	30 Oct	7,500
2009	26 Oct	16,850
Average		20,674

DISCUSSION

To evaluate whether the BEG was met, a precise estimate of escapement was required. During 2007–2009, the majority of the Chena River Chinook salmon run was enumerated under good viewing conditions. These conditions led to precise estimates of escapement where the estimates and their confidence intervals fell within the established BEG (2007: 95% CI=3,363-4,235; 2008: 95% CI=2,819-3,597; 2009: 95% CI=4,801-5,705).

In 2007 and 2008, the precision of sex and age composition estimates was limited by our ability to collect enough carcasses. Heavy rains led to unfavorable conditions for carcass collection. Although imprecise, the sex and age composition estimates of the escapement were similar to the 10 yr average, with the exception of age 3 salmon in 2007. This difference was likely due to the low sample size (62).

Since 1997, run duration and timing of Chena River Chinook salmon past the counting tower has been relatively consistent. Excluding counts from 1993 and 1994 because it was likely salmon passed the tower site before counting began, the duration of the run has ranged from 31 to 43 d with 50% of the run past the counting tower between days 14 and 25.

In 2007–2009, the DCR boat count was conducted over 1–2 days in good conditions which produced minimum estimates of escapement within the established SEG. Previous studies expanded the boat count to account for the escapement to inaccessible tributaries in the DCR drainage. This expansion was done to conduct a spawner-recruit analysis and in no way was it used to evaluate whether or not the SEG was met. For this reason, the minimum escapement estimates reported in this study were used to evaluate whether or not the established SEG was met in 2007–2009.

To obtain precise estimates of the sex and age composition of the escapement, carcass surveys need to start before the end of the run is enumerated. In 2010, a crew of three will begin sampling for carcasses on 28 July. This crew will be joined by a second crew as soon as the Chinook salmon run has concluded.

REFERENCES CITED

Cochran, W. G. 1977. Sampling Techniques. 3rd edition, John Wiley, New York.

Eiler, J. H., T. R. Spencer, J. J. Pella, M. M. Masuda, and R. R. Holder. 2004. Distribution and movement patterns of Chinook salmon returning to the Yukon River Basin in 2000-2002. U. S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-148.

Eiler, J. H., T. R. Spencer, J. J. Pella, and M. M. Masuda. 2006a. Stock composition, run timing, and movement patterns of Chinook salmon returning to the Yukon River Basin in 2003. U. S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-163.

Eiler, J. H., T. R. Spencer, J. J. Pella, and M. M. Masuda. 2006b. Stock composition, run timing, and movement patterns of Chinook salmon returning to the Yukon River Basin in 2004. U. S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-165.

Evenson, M. J. 1995. Salmon studies in Interior Alaska, 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-5, Anchorage.

Evenson, M. J. 1996. Salmon studies in Interior Alaska, 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-17, Anchorage.

Evenson, M. J. and L. Stuby. 1997. Salmon studies in Interior Alaska, 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-31, Anchorage.

Goodman, L. A. 1960. On the exact variance of products. Journal of the American Statistical Association. 55:708-713.

JTC (Joint Technical Committee of the Yukon River US/Canada Panel). 2009. Yukon River salmon 2008 season summary and 2009 season outlook. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A09-01, Anchorage.

Jennings, G. B., K. Sundet, and A. E. Bingham. 2007. Participation, catch, and harvest in Alaska sport fisheries during 2004. Alaska Department of Fish and Game, Fishery Data Series No. 07-40, Anchorage.

Jennings, G. B., K. Sundet, and A. E. Bingham. 2009a. Estimates of participation, catch, and harvest in Alaska sport fisheries during 2005. Alaska Department of Fish and Game, Fishery Data Series No. 09-47, Anchorage.

REFERENCES CITED (Continued)

Jennings, G. B., K. Sundet, and A. E. Bingham. 2009b. Estimates of participation, catch, and harvest in Alaska sport fisheries during 2006. Alaska Department of Fish and Game, Fishery Data Series No. 09-54, Anchorage.

Jennings, G. B., K. Sundet, and A. E. Bingham. 2010a. Estimates of participation, catch, and harvest in Alaska sport fisheries during 2007. Alaska Department of Fish and Game, Fishery Data Series No. 10-02, Anchorage.

Jennings, G. B., K. Sundet, and A. E. Bingham. 2010b. Estimates of participation, catch, and harvest in Alaska sport fisheries during 2008. Alaska Department of Fish and Game, Fishery Data Series No. 10-22, Anchorage.

Mosher, K. H. 1969. Identification of Pacific salmon and steelhead trout by scale characteristics. United States Department of the Interior, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, Washington, D.C., Circular 317.

Parker, J. F. 1991. Status of coho salmon in the Delta Clearwater River of interior Alaska. Alaska Department of Fish and Game, Fishery Manuscript No. 91-4, Anchorage.

Parker, J. F. 2006. Fishery Management Report for Sport Fisheries in the Upper Tanana River drainage in 2005. Alaska Department of Fish and Game, Fishery Management Report, Anchorage.

Stuby, L., and M. J. Evenson. 1998. Salmon studies in Interior Alaska, 1997. Alaska Department of Fish and Game, Fishery Data Series No. 97-11, Anchorage.

Stuby, L. 1999. Salmon studies in Interior Alaska, 1998. Alaska Department of Fish and Game, Fishery Data Series No. 99-31, Anchorage.

Stuby, L. 2000. Salmon studies in Interior Alaska, 1999. Alaska Department of Fish and Game, Fishery Data Series No. 00-4, Anchorage.

Stuby, L. 2001. Salmon studies in Interior Alaska, 2000. Alaska Department of Fish and Game, Fishery Data Series No. 01-24, Anchorage.

Welander, A. D. 1940. A study of the development of the scale of the Chinook salmon (*Oncorhynchus tshawytscha*). Master’s thesis, University of Washington, Seattle.

APPENDIX A–
SALCHA RIVER
CHINOOK SALMON COUNTING TOWER

APPENDIX A – data summaries and estimates of escapement of Chinook salmon from counting tower projects by Bering Sea Fisherman's Association (BSFA) on the Salcha River, 2007–2009.

INTRODUCTION

Bering Sea Fishermen's Association began tower counts on the Salcha River in 1999 and the Goodpaster River in 2004 (in cooperation with Tanana Chiefs Conference). Further details regarding these projects can be obtained by contacting the Bering Sea Fishermen's Association.

METHODS

Project mobilization, escapement enumeration, and data analysis procedures for the Salcha and Goodpaster river counting towers were virtually identical to those used for the Chena River.

RESULTS

SALCHA RIVER

In 2007, the Salcha River counting tower (Figure A1) was in operation from 30 June to 5 August when high water conditions suspended counts for the remainder of the season; the estimated Chinook salmon escapement during that time was 6,425 fish (SE=225, Tables A1 and A2). The estimated chum salmon escapement during that time was 13,069 fish (SE=295, Table A3). Due to the high water event these estimates should be considered minimum estimates of escapement.

In 2008, the counting tower was in operation from 5 July to 10 September; the estimated Chinook salmon escapement during that time was 2,731 fish (SE=169, Tables A1 and A4). The estimated chum salmon escapement during that time was 2,212 fish (SE=94, Table A5). Due to multiple high water events (12–13 July, 20–28 July, and 29 July–28 August), these estimates should be considered minimum estimates of escapement.

In 2009, the counting tower was in operation from 6 July to 10 August; the estimated Chinook salmon escapement during that time was 12,774 fish (SE=405, Tables A1 and A6). The estimated chum salmon escapement during that time was 31,035 fish (SE=800, Table A7).

BSFA is reporting total estimates of escapement in their annual summary of projects that expand interrupted tower counts greater than 4 days based on different techniques than ADF&G; therefore, total estimates of escapement may differ when the number of days with no counts exceeds 4 days.

AGE-SEX-LENGTH COMPOSITIONS

In 2007, a total of 308 Chinook salmon carcasses were collected along the Salcha River from 28 July through 13 August. The estimated proportion of females in the escapement from the carcass survey was 0.36 (SE=0.03) and the gender-bias corrected estimate was 0.31 (SE=0.07) (Table A8). The largest age class for males (37%) was age 5 and the largest age class for females (88%) was age 6 (Table A8).

In 2008, a total of 303 Chinook salmon carcasses were collected along the Salcha River from 28 July through 21 August. The estimated proportion of females in the escapement from the carcass survey was 0.39 (SE=0.03) and the gender-bias corrected estimate was 0.34 (SE=0.07) (Table A9). The largest age class for males (66%) was age 5 and the largest age class for females (66%) was age 6 (Table A9).

In 2009, a total of 511 Chinook salmon carcasses were collected along the Salcha River from 24 July through 19 August. The estimated proportion of females in the escapement from the carcass survey was 0.39 (SE=0.02) and the gender-bias corrected estimate was 0.34 (SE=0.07) (Table A10). The largest age class for males (52%) was age 4 and the largest age class for females (94%) was age 6 (Table A10).

Age composition (adjusted and unadjusted) and escapement estimates by gender and for all fish are variable over time but no significant changes were observed (Table A11).

APPENDIX A – data summaries and estimates of escapement of Chinook salmon from counting tower projects by Bering Sea Fisherman's Association (BSFA) on the Salcha River, 2007–2009.

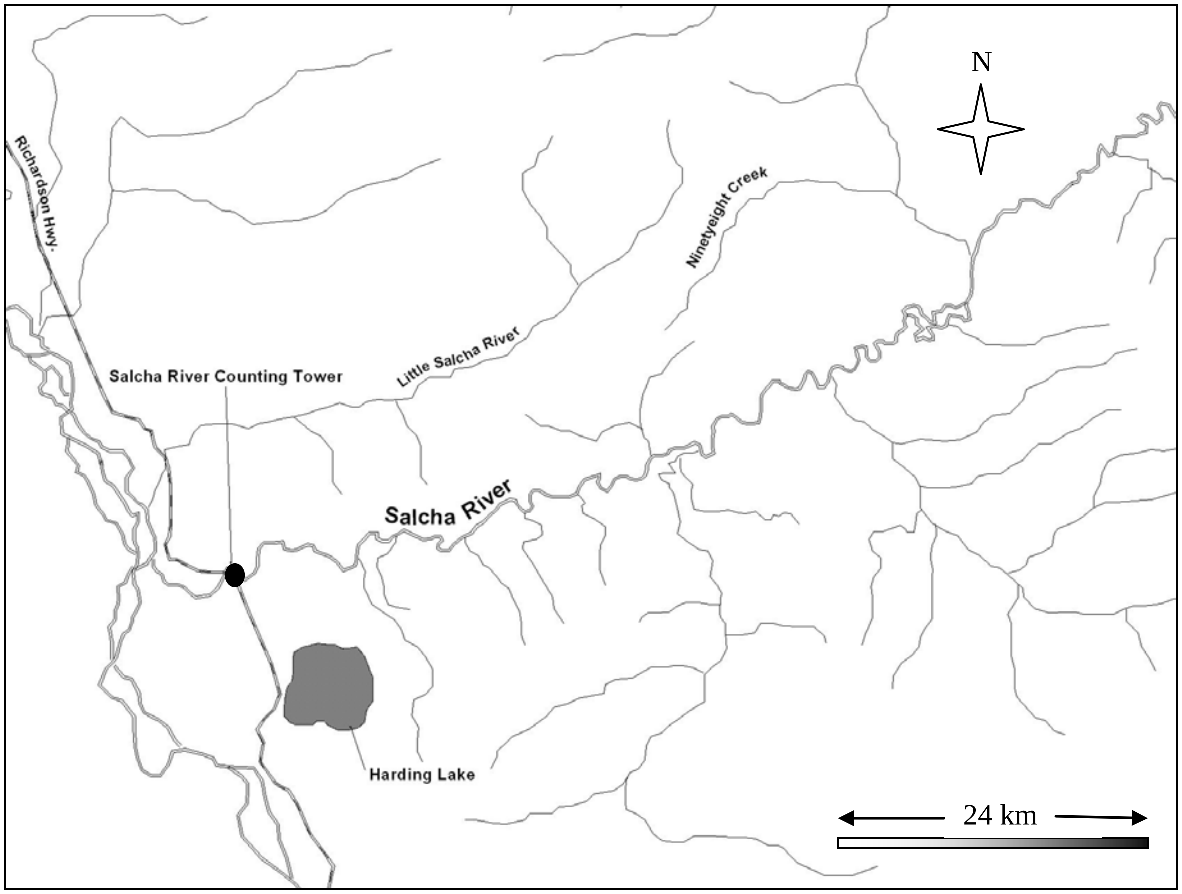

Figure A1.–Map of the Salcha River demarcating the counting tower.

APPENDIX A – data summaries and estimates of escapement of Chinook salmon from counting tower projects by Bering Sea Fisherman's Association (BSFA) on the Salcha River, 2007–2009.

Table A1.–Estimates of the Salcha River Chinook salmon escapement, 1987–2009.

Year	Escapement Estimate	SE	Method
1987	4,771	504	Mark-Recapture
1988	4,322	556	Mark-Recapture
1989	3,294	630	Mark-Recapture
1990	10,728	1,404	Mark-Recapture
1991	5,608	664	Mark-Recapture
1992	7,862	975	Mark-Recapture
1993	10,007	360	Counting Tower
1994	18,399	549	Counting Tower
1995	13,643	471	Counting Tower
1996	7,570	1,238	Mark-Recapture
1997	18,514	1,043	Counting Tower
1998	5,027	331	Counting Tower
1999	9,198	290	Counting Tower
2000	4,595	802	Counting Tower
2001	13,328	2,163	Counting Tower
2002	9,000[a]	160	Counting Tower
2003	15,500[a]	747	Counting Tower
2004	15,761	612	Counting Tower
2005	5,988	163	Counting Tower
2006	10,679	315	Counting Tower
2007	6,425	225	Counting Tower
2008	5,415[a]	169	Counting Tower
2009	12,774	405	Counting Tower

[a] Estimate was obtained from an expansion of the interrupted tower-count.

.

APPENDIX A – data summaries and estimates of escapement of Chinook salmon from counting tower projects by Bering Sea Fisherman's Association (BSFA) on the Salcha River, 2007–2009.

Table A2.–Daily estimates of Salcha River Chinook salmon escapement, 2007. Shaded cells indicate days estimated using the moving average estimator due to water clarity conditions.

Date	Day of Run	Number of 20 Min. Counts	Number Counted	Daily Escapement	Daily SE
30-Jun	0	5	0	0	0
1-Jul	0	24	0	0	0
2-Jul	1	24	5	15	13
3-Jul	2	24	1	3	3
4-Jul	3	24	0	0	0
5-Jul	4	24	5	15	11
6-Jul	5	24	0	0	7
7-Jul	6	24	2	6	4
8-Jul	7	8	2	13	3
9-Jul	8	0	0	25	18
10-Jul	9	0	0	41	25
11-Jul	10	8	4	80	20
12-Jul	11	24	14	42	8
13-Jul	12	24	21	63	15
14-Jul	13	24	31	93	18
15-Jul	14	24	66	198	36
16-Jul	15	24	71	213	48
17-Jul	16	24	79	237	32
18-Jul	17	24	170	510	39
19-Jul	18	24	163	489	62
20-Jul	19	24	148	444	37
21-Jul	20	24	249	747	88
22-Jul	21	24	243	729	76
23-Jul	22	24	166	498	57
24-Jul	23	8	7	441	112
25-Jul	24	8	1	227	57
26-Jul	25	24	32	96	22
27-Jul	26	24	29	87	19
28-Jul	27	24	43	129	20
29-Jul	28	24	50	150	20
30-Jul	29	24	46	138	28
31-Jul	30	24	49	147	13
1-Aug	31	24	41	123	22
2-Aug	32	24	35	105	17
3-Aug	33	24	10	30	8
4-Aug	34	24	36	108	16
5-Aug	35	24	40	120	21
6-Aug	36	24	21	63	15
Total	-	-	1,880	6,425	225

Table A3.–Daily estimates of Salcha River chum salmon escapement, 2007. Shaded cells indicate days estimated using the moving average estimator due to water clarity conditions.

Date	Day of Run	Number of 20 Min. Counts	Number Counted	Daily Escapement	Daily SE
30-Jun	0	6	0	0	0
1-Jul	0	24	0	0	0
2-Jul	0	24	0	0	0
3-Jul	0	24	0	0	0
4-Jul	0	24	0	0	0
5-Jul	0	24	0	0	0
6-Jul	0	24	0	0	0
7-Jul	0	24	0	0	0
8-Jul	0	8	0	0	0
9-Jul	0	0	0	0	0
10-Jul	0	0	0	0	0
11-Jul	0	8	0	0	0
12-Jul	0	24	0	0	0
13-Jul	0	24	0	0	0
14-Jul	0	24	0	0	0
15-Jul	0	24	0	0	0
16-Jul	0	24	0	0	0
17-Jul	0	24	0	0	0
18-Jul	1	24	3	9	6
19-Jul	2	24	30	90	16
20-Jul	3	24	22	66	12
21-Jul	4	24	24	72	16
22-Jul	5	24	25	75	17
23-Jul	6	24	30	90	16
24-Jul	7	0	0	104	15
25-Jul	8	0	0	236	35
26-Jul	9	24	49	147	21
27-Jul	10	24	157	471	38
28-Jul	11	24	191	573	62
29-Jul	12	24	196	588	42
30-Jul	13	24	255	765	85
31-Jul	14	24	281	843	56
1-Aug	15	24	293	879	70
2-Aug	16	24	423	1,269	98
3-Aug	17	24	449	1,347	78
4-Aug	18	24	602	1,806	101
5-Aug	19	24	623	1,869	134
6-Aug	20	24	590	1,770	132
Total	-	-	4,243	13,069	295

APPENDIX A – data summaries and estimates of escapement of Chinook salmon from counting tower projects by Bering Sea Fisherman's Association (BSFA) on the Salcha River, 2007–2009.

Table A4.–Daily estimates of Salcha River Chinook salmon escapement, 2008. Shaded cells indicate days estimated using the moving average estimator due to water clarity conditions.

Date	Day of Run	Number of 20 Min. Counts	Number Counted	Daily Escapement	Daily SE
5-Jul	0	5	0	0	0
6-Jul	1	24	37	111	62
7-Jul	2	24	36	108	25
8-Jul	3	24	47	141	53
9-Jul	4	24	56	168	40
10-Jul	5	24	64	192	55
11-Jul	6	24	45	135	29
12-Jul	7	0	0	156	40
13-Jul	8	0	0	107	27
14-Jul	9	24	47	141	33
15-Jul	10	24	15	45	9
16-Jul	11	24	106	318	59
17-Jul	12	24	69	207	36
18-Jul	13	24	176	528	73
19-Jul	14	24	107	321	44
20-Jul[a]	15	0	0	0	0
21-Jul[a]	16	0	0	0	0
22-Jul[a]	17	0	0	0	0
23-Jul[a]	18	0	0	0	0
24-Jul[a]	19	0	0	0	0
25-Jul[a]	20	0	0	0	0
26-Jul[a]	21	0	0	0	0
27-Jul[a]	22	0	0	0	0
28-Jul	23	19	16	53	18
Total	-	-	821	2,731	169

[a] Interpolated estimates were not calculated because more than 4 days of counts were missed due to a flood event.

Table A5.–Daily estimates of Salcha River chum salmon escapement, 2008. Shaded cells indicate days estimated using the moving average estimator due to water clarity conditions.

Date	Day of Run	Number of 20 Min. Counts	Number Counted	Daily Escapement	Daily SE
5-Jul	0	5	0	0	0
6-Jul	0	24	0	0	0
7-Jul	0	24	0	0	0
8-Jul	0	24	0	0	0
9-Jul	0	24	0	0	0
10-Jul	0	24	0	0	0
11-Jul	0	24	0	0	0
12-Jul	0	0	0	0	0
13-Jul	0	0	0	0	0
14-Jul	0	24	0	0	0
15-Jul	0	24	0	0	0
16-Jul	1	24	7	21	9
17-Jul	2	24	6	18	7
18-Jul	3	24	14	42	8
19-Jul	4	24	9	27	12
20–27-Jul[a]	5-12	0	0	0	0
28-Jul	13	19	117	476	77
29-Jul–27 Aug[a]	14-43	0	0	0	0
28-Aug	44	12	18	122	34
29-Aug	45	24	22	66	16
30-Aug	46	24	31	93	18
31-Aug	47	24	34	102	0
1-Sep	48	24	40	120	0
2-Sep	49	24	27	81	18
3-Sep	50	24	47	141	0
4-Sep	51	24	56	168	0
5-Sep	52	24	88	264	17
6-Sep	53	24	59	177	0
7-Sep	54	24	34	102	0
8-Sep	55	24	22	66	14
9-Sep	56	24	15	45	0
10-Sep	57	13	17	82	0
Total	-	-	663	2,212	94

[a] Interpolated estimates were not calculated because more than 4 days of counts were missed due to a flood event.

Table A6.–Daily estimates of Salcha River Chinook salmon escapement, 2009.

Date	Day of Run	Number of 20 Min. Counts	Number Counted	Daily Escapement	Daily SE
6-Jul	1	6	2	24	4.4
7-Jul	2	24	13	39	16.2
8-Jul	3	24	32	96	18.6
9-Jul	4	24	69	207	49.1
10-Jul	5	24	46	138	27.5
11-Jul	6	24	78	234	70.6
12-Jul	7	24	82	246	48.5
13-Jul	8	24	173	519	43.8
14-Jul	9	24	306	918	83.7
15-Jul	10	24	328	984	176.9
16-Jul	11	24	58	174	30.7
17-Jul	12	24	55	165	24.5
18-Jul	13	24	269	807	96.0
19-Jul	14	24	145	435	71.5
20-Jul	15	24	284	852	98.8
21-Jul	16	24	178	534	41.9
22-Jul	17	24	344	1032	157.2
23-Jul	18	24	220	660	62.8
24-Jul	19	24	180	540	89.3
25-Jul	20	24	137	411	120.9
26-Jul	21	24	317	951	146.4
27-Jul	22	24	199	597	63.7
28-Jul	23	24	196	588	45.5
29-Jul	24	24	86	258	34.4
30-Jul	25	24	54	162	22.9
31-Jul	26	24	70	210	21.6
1-Aug	27	24	87	261	43.5
2-Aug	28	24	83	249	27.2
3-Aug	29	24	32	96	16.6
4-Aug	30	24	38	114	18.3
5-Aug	31	24	20	60	14.8
6-Aug	32	24	11	33	11.4
7-Aug	33	24	6	18	3.7
8-Aug	34	24	37	111	30.8
9-Aug	35	24	10	30	9.4
10-Aug	36	24	7	21	6.7
Total	-	-	4,252	12,774	405

Table A7.–Daily estimates of Salcha River chum salmon escapement, 2009.

Date	Day of Run	Number of 20 Min. Counts	Number Counted	Daily Escapement	Daily SE
6-Jul	0	6	0	0	-
7-Jul	0	24	0	0	0.0
8-Jul	0	24	0	0	0.0
9-Jul	0	24	0	0	0.0
10-Jul	0	24	0	0	0.0
11-Jul	0	24	0	0	0.0
12-Jul	0	24	0	0	0.0
13-Jul	0	24	0	0	0.0
14-Jul	0	24	0	0	0.0
15-Jul	1	24	39	117	21.8
16-Jul	2	24	77	231	39.3
17-Jul	3	24	110	330	40.4
18-Jul	4	24	85	255	35.9
19-Jul	5	24	396	1188	312.4
20-Jul	6	24	374	1122	182.8
21-Jul	7	24	103	309	68.6
22-Jul	8	24	80	240	41.7
23-Jul	9	24	96	288	45.2
24-Jul	10	24	259	777	119.8
25-Jul	11	24	218	654	93.5
26-Jul	12	24	421	1263	170.9
27-Jul	13	24	400	1200	96.4
28-Jul	14	24	547	1641	163.3
29-Jul	15	24	612	1836	159.3
30-Jul	16	24	557	1671	180.5
31-Jul	17	24	594	1782	124.7
1-Aug	18	24	471	1413	290.8
2-Aug	19	24	322	966	137.5
3-Aug	20	24	606	1818	119.5
4-Aug	21	24	807	2421	275.3
5-Aug	22	24	889	2667	174.3
6-Aug	23	24	473	1419	123.1
7-Aug	24	24	349	1047	68.3
8-Aug	25	24	330	990	130.3
9-Aug	26	24	588	1764	242.8
10-Aug	27	24	542	1626	120.0
Total	-	-	10,345	31,035	800

Table A8.–Estimated proportions and mean length by age and sex of Chinook salmon sampled during the Salcha River carcass survey, 2007.

	Sample	Sample	Length	
Age[a]	Size	Proportion	Mean	SE
Males				
1.2	68	0.34	538	6
1.3	72	0.37	684	7
1.4	58	0.29	819	10
Total Aged	198			
Total Males	198	0.64		
Adjusted Total[b]		0.69		
Females				
1.2	1	0.01	590	-
1.3	11	0.10	748	10
1.4	97	0.88	842	6
1.5	1	0.01	910	-
Total Aged	110			
Total Females	110	0.36		
Adjusted Total[b]		0.31		

[a] Age is represented by the number of annuli formed during river residence and ocean residence (i.e., an age of 1.4 represents one annulus formed during river residence and four annuli formed during ocean residence plus one year for year of spawning for a total age of 6 years).

[b] Estimated proportion of females was corrected by a factor of 0.867.

Table A9.–Estimated proportions and mean length by age and sex of Chinook salmon sampled during the Salcha River carcass survey, 2008.

Age[a]	Sample Size	Sample Proportion	Length Mean	Length SE
Males				
1.1	2	0.01	395	5
1.2	30	0.16	543	12
1.3	121	0.66	718	6
1.4	31	0.17	853	18
Total Aged	184			
Total Males	215	0.61		
Adjusted Total[b]		0.66		
Females				
1.3	36	0.30	779	6
1.4	78	0.66	851	5
1.5	5	0.04	878	18
Total Aged	119			
Total Females	137	0.39		
Adjusted Total[b]		0.34		

[a] Age is represented by the number of annuli formed during river residence and ocean residence (i.e., an age of 1.4 represents one annulus formed during river residence and four annuli formed during ocean residence plus one year for year of spawning for a total age of 6 years).

[b] Totals include those Chinook salmon which could not be aged.

[c] Estimated proportion of females was corrected by a factor of 0.867.

Table A10.–Estimated proportions and mean length by age and sex of Chinook salmon sampled during the Salcha River carcass survey, 2009.

Age[a]	Sample Size	Sample Proportion	Length Mean	Length SE
Males				
1.2	145	0.52	583	3
1.3	88	0.32	696	5
1.4	46	0.16	859	11
Total Aged	279			
Total Males	311	0.61		
Adjusted Total[b]		0.66		
Females				
1.3	10	0.05	775	17
1.4	168	0.94	866	3
1.5	1	0.01	890	-
Total Aged	179			
Total Females	200	0.39		
Adjusted Total[b]		0.34		

[a] Age is represented by the number of annuli formed during river residence and ocean residence (i.e., an age of 1.4 represents one annulus formed during river residence and four annuli formed during ocean residence plus one year for year of spawning for a total age of 6 years).

[b] Totals include those Chinook salmon which could not be aged.

[c] Estimated proportion of females was corrected by a factor of 0.867.

APPENDIX A – data summaries and estimates of escapement of Chinook salmon from counting tower projects by Bering Sea Fisherman's Association (BSFA) on the Salcha River, 2007–2009.

Table A11.–Age composition and escapement estimates by gender and by all fish combined (unadjusted and adjusted) of Salcha River Chinook salmon, 1987–2009.

	Total Age (years)/European Age (freshwater years/ocean years)										Male	Male
Males	3	4	5		6		7		8		Unadjusted[a]	Adjusted[b]
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Escapement	Escapement
1987	0.005	0.152	0.275	0.000	0.544	0.000	0.025	0.000	0.000	0.000	1,766	2,290
1988	0.007	0.333	0.330	0.000	0.243	0.000	0.083	0.003	0.000	0.000	2,223	2,363
1989	0.012	0.107	0.548	0.000	0.333	0.000	0.000	0.000	0.000	0.000	1,477	1,853
1990	0.004	0.333	0.352	0.000	0.268	0.000	0.042	0.000	0.000	0.000	5,832	6,845
1991	0.004	0.143	0.489	0.000	0.309	0.000	0.051	0.000	0.004	0.000	3,082	3,325
1992	0.019	0.543	0.338	0.007	0.084	0.005	0.005	0.000	0.000	0.000	5,020	5,031
1993	0.012	0.384	0.454	0.000	0.146	0.003	0.000	0.000	0.000	0.000	7,364	7,613
1994	0.010	0.035	0.561	0.000	0.366	0.000	0.028	0.000	0.000	0.000	9,825	11,251
1995	0.000	0.296	0.292	0.000	0.388	0.000	0.021	0.004	0.000	0.000	6,013	7,023
1996	0.054	0.118	0.567	0.000	0.177	0.000	0.084	0.000	0.000	0.000	3,777	5,588
1997	0.000	0.256	0.244	0.000	0.489	0.000	0.011	0.000	0.000	0.000	9,597	10,488
1998	0.035	0.070	0.756	0.000	0.128	0.000	0.012	0.000	0.000	0.000	3,532	3,716
1999	0.000	0.201	0.374	0.000	0.424	0.000	0.000	0.000	0.000	0.000	4,471	4,834
2000	0.000	0.304	0.565	0.000	0.130	0.000	0.000	0.000	0.000	0.000	2,776	2,846
2001	0.008	0.167	0.425	0.000	0.400	0.000	0.000	0.000	0.000	0.000	8,395	8,995
2002	0.000	0.554	0.190	0.000	0.179	0.000	0.076	0.000	0.000	0.000	5,907	6,288
2003	0.011	0.126	0.598	0.000	0.241	0.000	0.023	0.000	0.000	0.000	8,964	10,181
2004	0.000	0.247	0.176	0.000	0.576	0.000	0.000	0.000	0.000	0.000	5,910	7,168
2005	0.000	0.204	0.516	0.000	0.265	0.000	0.011	0.004	0.000	0.000	2,709	3,168
2006	0.000	0.101	0.715	0.000	0.174	0.000	0.010	0.000	0.000	0.000	5,989	6,659
2007	0.000	0.343	0.364	0.000	0.293	0.000	0.000	0.000	0.000	0.000	4,130	4,436
2008	0.011	0.163	0.658	0.000	0.168	0.000	0.000	0.000	0.000	0.000	3,307	3,571
2009	0.000	0.520	0.315	0.000	0.165	0.000	0.000	0.000	0.000	0.000	7,774	8,446
Average	0.008	0.248	0.439	0.000	0.282	0.000	0.021	0.000	0.000	0.000	5,211	5,825

-continued-

Table A11.–Page 2 of 4.

	Total Age (years)/European Age (freshwater years/ocean years)										Female	Female
Females	3	4	5		6		7		8		Unadjusted[a]	Adjusted[b]
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Escapement	Escapement
1987	0.000	0.003	0.038	0.000	0.849	0.000	0.110	0.000	0.000	0.000	3,005	2,481
1988	0.000	0.005	0.066	0.000	0.690	0.000	0.239	0.000	0.000	0.000	2,099	1,959
1989	0.000	0.000	0.131	0.000	0.730	0.000	0.139	0.000	0.000	0.000	1,817	1,441
1990	0.000	0.008	0.147	0.000	0.713	0.000	0.132	0.000	0.000	0.000	4,896	3,883
1991	0.000	0.000	0.133	0.000	0.680	0.000	0.183	0.000	0.004	0.000	2,526	2,283
1992	0.000	0.005	0.327	0.000	0.650	0.000	0.014	0.005	0.000	0.000	2,842	2,831
1993	0.000	0.008	0.224	0.000	0.736	0.000	0.032	0.000	0.000	0.000	2,643	2,394
1994	0.000	0.017	0.185	0.000	0.721	0.004	0.073	0.000	0.000	0.000	8,574	7,148
1995	0.000	0.010	0.138	0.000	0.816	0.000	0.030	0.007	0.000	0.000	7,630	6,620
1996	0.000	0.005	0.205	0.000	0.390	0.000	0.400	0.000	0.000	0.000	3,793	1,982
1997	0.000	0.033	0.044	0.000	0.900	0.000	0.022	0.000	0.000	0.000	8,917	8,026
1998	0.000	0.000	0.649	0.000	0.297	0.000	0.054	0.000	0.000	0.000	1,495	1,311
1999	0.000	0.000	0.131	0.000	0.863	0.000	0.006	0.000	0.000	0.000	4,727	4,364
2000	0.000	0.111	0.389	0.000	0.389	0.000	0.111	0.000	0.000	0.000	1,819	1,749
2001	0.000	0.000	0.194	0.000	0.722	0.000	0.083	0.000	0.000	0.000	4,933	4,333
2002	0.000	0.000	0.041	0.000	0.776	0.000	0.184	0.000	0.000	0.000	3,093	2,712
2003	0.000	0.000	0.211	0.000	0.754	0.000	0.035	0.000	0.000	0.000	6,536	5,319
2004	0.000	0.000	0.028	0.000	0.958	0.000	0.014	0.000	0.000	0.000	9,851	8,593
2005	0.000	0.000	0.330	0.000	0.627	0.000	0.043	0.000	0.000	0.000	3,279	2,820
2006	0.000	0.000	0.204	0.000	0.760	0.005	0.032	0.000	0.000	0.000	4,690	4,020
2007	0.000	0.009	0.100	0.000	0.882	0.000	0.009	0.000	0.000	0.000	2,295	1,989
2008	0.000	0.000	0.303	0.000	0.655	0.000	0.042	0.000	0.000	0.000	2,108	1,844
2009	0.000	0.000	0.056	0.000	0.939	0.000	0.006	0.000	0.000	0.000	5,000	4,328
Average	0.000	0.009	0.186	0.000	0.717	0.000	0.087	0.000	0.000	0.000	4,285	3,671

-continued-

APPENDIX A – data summaries and estimates of escapement of Chinook salmon from counting tower projects by Bering Sea Fisherman's Association (BSFA) on the Salcha River, 2007–2009.

Table A11.–Page 3 of 4.

Unadjusted[b]	Total Age (years)/European Age (freshwater years/ocean years)											
All Fish	3	4	5		6		7		8		Total	
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Escapement	Method[c]
1987	0.002	0.058	0.126	0.000	0.736	0.000	0.078	0.000	0.000	0.000	4,771	MR
1988	0.004	0.203	0.225	0.000	0.421	0.000	0.145	0.002	0.000	0.000	4,322	MR
1989	0.005	0.041	0.290	0.000	0.579	0.000	0.086	0.000	0.000	0.000	3,294	MR
1990	0.002	0.169	0.249	0.000	0.492	0.000	0.087	0.000	0.000	0.000	10,728	MR
1991	0.002	0.076	0.322	0.000	0.483	0.000	0.113	0.000	0.004	0.000	5,608	MR
1992	0.012	0.361	0.334	0.005	0.276	0.003	0.008	0.002	0.000	0.000	7,862	MR
1993	0.009	0.280	0.391	0.000	0.309	0.002	0.009	0.000	0.000	0.000	10,007	CT
1994	0.006	0.027	0.392	0.000	0.525	0.002	0.048	0.000	0.000	0.000	18,399	CT
1995	0.000	0.136	0.206	0.000	0.628	0.000	0.026	0.006	0.000	0.000	13,643	CT
1996	0.027	0.061	0.383	0.000	0.286	0.000	0.245	0.000	0.000	0.000	7,570	MR
1997	0.000	0.144	0.144	0.000	0.694	0.000	0.017	0.000	0.000	0.000	18,514	CT
1998	0.024	0.049	0.724	0.000	0.179	0.000	0.024	0.000	0.000	0.000	5,027	CT
1999	0.000	0.091	0.241	0.000	0.664	0.000	0.003	0.000	0.000	0.000	9,198	CT
2000	0.000	0.220	0.488	0.000	0.244	0.000	0.049	0.000	0.000	0.000	4,595	CT
2001	0.005	0.104	0.339	0.000	0.521	0.000	0.031	0.000	0.000	0.000	13,328	CT
2002	0.000	0.362	0.138	0.000	0.387	0.000	0.113	0.000	0.000	0.000	9,000[d]	CT
2003	0.007	0.076	0.444	0.000	0.444	0.000	0.028	0.000	0.000	0.000	15,500[d]	CT
2004	0.000	0.092	0.083	0.000	0.817	0.000	0.009	0.000	0.000	0.000	15,761	CT
2005	0.000	0.093	0.415	0.000	0.462	0.000	0.028	0.002	0.000	0.000	5,988	CT
2006	0.000	0.057	0.493	0.000	0.428	0.002	0.020	0.000	0.000	0.000	10,679	CT
2007	0.000	0.224	0.269	0.000	0.503	0.000	0.003	0.000	0.000	0.000	6,425	CT
2008	0.007	0.099	0.518	0.000	0.360	0.000	0.017	0.000	0.000	0.000	5,415[d]	CT
2009	0.000	0.317	0.214	0.000	0.467	0.000	0.002	0.000	0.000	0.000	12,774	CT
Average	0.005	0.145	0.323	0.000	0.474	0.000	0.052	0.000	0.000	0.000	9,496	

-continued-

Table A11.–Page 4 of 4.

Adjusted	Total Age (years)/European Age (freshwater years/ocean years)											
All Fish	3	4	5		6		7		8		Total	
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Escapement	Method[c]
1987	0.002	0.074	0.151	0.000	0.703	0.000	0.069	0.000	0.000	0.000	4,771	MR
1988	0.004	0.185	0.210	0.000	0.446	0.000	0.154	0.002	0.000	0.000	4,322	MR
1989	0.007	0.060	0.366	0.000	0.507	0.000	0.061	0.000	0.000	0.000	3,294	MR
1990	0.002	0.215	0.278	0.000	0.429	0.000	0.075	0.000	0.000	0.000	10,728	MR
1991	0.002	0.085	0.344	0.000	0.460	0.000	0.105	0.000	0.004	0.000	5,608	MR
1992	0.012	0.349	0.334	0.004	0.288	0.003	0.008	0.002	0.000	0.000	7,862	MR
1993	0.009	0.294	0.399	0.000	0.287	0.002	0.008	0.000	0.000	0.000	10,007	CT
1994	0.006	0.028	0.415	0.000	0.504	0.002	0.045	0.000	0.000	0.000	18,399	CT
1995	0.000	0.157	0.217	0.000	0.596	0.000	0.025	0.005	0.000	0.000	13,643	CT
1996	0.040	0.089	0.472	0.000	0.233	0.000	0.167	0.000	0.000	0.000	7,570	MR
1997	0.000	0.159	0.158	0.000	0.667	0.000	0.016	0.000	0.000	0.000	18,514	CT
1998	0.026	0.052	0.728	0.000	0.172	0.000	0.023	0.000	0.000	0.000	5,027	CT
1999	0.000	0.106	0.259	0.000	0.633	0.000	0.003	0.000	0.000	0.000	9,198	CT
2000	0.000	0.231	0.498	0.000	0.229	0.000	0.042	0.000	0.000	0.000	4,595	CT
2001	0.006	0.112	0.350	0.000	0.505	0.000	0.027	0.000	0.000	0.000	13,328	CT
2002	0.000	0.387	0.145	0.000	0.359	0.000	0.109	0.000	0.000	0.000	9,000[d]	CT
2003	0.008	0.083	0.465	0.000	0.417	0.000	0.027	0.000	0.000	0.000	15,500[d]	CT
2004	0.000	0.112	0.095	0.000	0.785	0.000	0.008	0.000	0.000	0.000	15,761	CT
2005	0.000	0.108	0.429	0.000	0.436	0.000	0.026	0.002	0.000	0.000	5,988	CT
2006	0.000	0.063	0.523	0.000	0.394	0.002	0.018	0.000	0.000	0.000	10,679	CT
2007	0.000	0.240	0.282	0.000	0.475	0.000	0.003	0.000	0.000	0.000	6,425	CT
2008	0.007	0.108	0.538	0.000	0.333	0.000	0.014	0.000	0.000	0.000	5,415[d]	CT
2009	0.000	0.343	0.227	0.000	0.427	0.000	0.002	0.000	0.000	0.000	12,774	CT
Average	0.006	0.158	0.343	0.000	0.447	0.000	0.045	0.000	0.000	0.000	9,496	

[a] Unadjusted escapement and composition estimates were derived from the observed sample proportions of males and females from carcass surveys.

[b] Adjusted escapement and composition estimates were derived either from mark-recapture estimates (MR) or in years when counting tower (CT) assessments were conducted, from carcass surveys that were adjusted using the methods described in Appendix A and do not necessarily reflect actual sample proportions.

[c] Escapement estimates were obtained from either a counting tower (CT) assessment or mark-recapture (MR) project.

[d] Estimate includes an expansion for missed counting days. SE is a minimum estimate and does not include uncertainty associated with expansion for missed days.

APPENDIX B
GOODPASTER RIVER
CHINOOK SALMON COUNTING TOWER

APPENDIX B – data summaries and estimates of escapement of Chinook salmon from counting tower projects by Tanana Chiefs Conference on the Goodpaster River, 2007–2009.

INTRODUCTION

Bering Sea Fishermen's Association began tower counts on the Goodpaster River in 2004 (in cooperation with Tanana Chiefs Conference). Further details regarding these projects can be obtained by contacting the Bering Sea Fishermen's Association.

METHODS

Project mobilization, escapement enumeration, and data analysis procedures for the Salcha and Goodpaster river counting towers were virtually identical to those used for the Chena River.

GOODPASTER RIVER

It is unknown what proportion of the Goodpaster River Chinook salmon stock may spawn up the South Fork of the river, but various surveys have shown little if any spawning occurring on the South Fork as habitat is unsuitable for at least the vast majority of the drainage, therefore the estimates of escapements produced by this project should not be considered totally inclusive, but rather representative of the Goodpaster River, until such time as the significance of the South Fork can be ascertained.

In 2007, the Goodpaster River counting tower (Figure B1) was in operation from 16 July to 27 July with high water conditions between 1 July and 15 July; the estimated Chinook salmon escapement was 1,581 fish (SE=82) (Tables B1 and B2). The estimate should be considered a minimum estimate of escapement.

In 2008, the tower was in operation from 8 July to 31 July with multiple high water conditions from 8 July through 28 July; the estimated Chinook salmon escapement was 1,880 (SE=85) (Tables B1 and B3).

In 2009, the tower was in operation from 7 July to 31 July with multiple high water conditions from 8 July through 14 July and 21 July through 24 July; the estimated Chinook salmon escapement was 4,280 (SE=167) (Tables B1 and B4).

The Goodpaster River has not been sampled for Chinook salmon ASL composition, although samples have been taken for genetic identification.

APPENDIX B – data summaries and estimates of escapement of Chinook salmon from counting tower projects by Tanana Chiefs Conference on the Goodpaster River, 2007–2009.

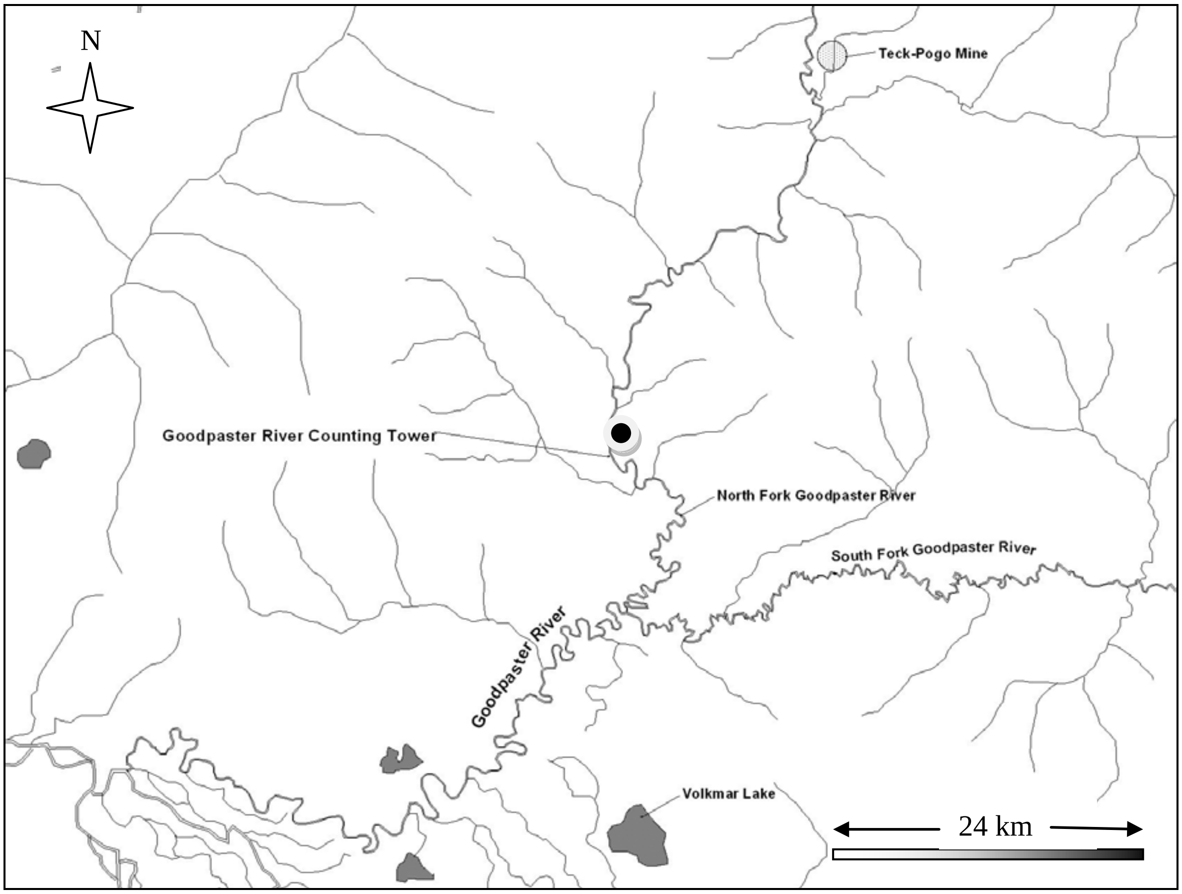

Figure B1.–Map of the Goodpaster River demarcating the counting tower.

APPENDIX B – data summaries and estimates of escapement of Chinook salmon from counting tower projects by Tanana Chiefs Conference on the Goodpaster River, 2007–2009.

Table B1.–Estimates of Goodpaster River Chinook salmon escapement, 2004–2009.

	Escapement	
Year	Estimate	SE
2004	3,673	106
2005	1,184	70
2006	2,479	100
2007	1,581	82
2008	1,880	85
2009	4,280	167

Table B2.–Daily estimates of Goodpaster River Chinook salmon escapement, 2007. Shaded cells indicate days estimated using the moving average estimator due to water clarity conditions.

Date	Day of Run	Number of 20 Min. Counts	Number Counted	Daily Escapement	Daily SE
1-Jul	0	0	0	0	0
2-Jul	0	0	0	0	0
3-Jul	0	0	0	0	0
4-Jul	0	0	0	0	0
5-Jul	0	0	0	0	0
6-Jul	0	0	0	0	0
7-Jul	0	0	0	0	0
8-Jul	0	0	0	0	0
9-Jul	0	0	0	0	0
10-Jul	0	0	0	0	0
11-Jul	0	0	0	0	0
12-Jul	0	0	0	0	0
13-Jul	0	0	0	0	0
14-Jul	0	0	0	0	0
15-Jul	1	1	1	77	17
16-Jul	2	24	51	153	32
17-Jul	3	24	71	213	36
18-Jul	4	24	43	129	14
19-Jul	5	24	75	225	40
20-Jul	6	24	86	258	35
21-Jul	7	23	42	134	27
22-Jul	8	24	47	141	24
23-Jul	9	24	26	78	17
24-Jul	10	15	3	47	10
25-Jul	11	24	5	15	8
26-Jul	12	24	14	42	12
27-Jul	13	11	4	26	6
28-Jul	14	0	0	21	5
29-Jul	15	0	0	17	4
30-Jul	16	0	0	6	1
31-Jul	17	24	0	0	0
1-Aug	18	12	0	0	0
Total			468	1,581	82

Table B3.–Daily estimates of Goodpaster River Chinook salmon escapement, 2008. Shaded cells indicate days estimated using the moving average estimator due to water clarity conditions.

Date	Day of Run	Number of 20 Min. Counts	Number Counted	Daily Escapement	Daily SE
1-Jul	0	0	0	0	0
2-Jul	0	0	0	0	0
3-Jul	0	0	0	0	0
4-Jul	0	0	0	0	0
5-Jul	0	0	0	0	0
6-Jul	0	0	0	0	0
7-Jul	0	0	0	0	0
8-Jul	0	0	0	0	0
9-Jul	0	0	0	0	0
10-Jul	0	0	0	0	0
11-Jul	0	0	0	0	0
12-Jul	0	0	0	0	0
13-Jul	0	0	0	0	0
14-Jul	0	6	0	0	0
15-Jul	1	15	0	0	0
16-Jul	2	19	44	132	20
17-Jul	3	24	36	108	24
18-Jul	4	24	119	357	55
19-Jul	5	24	62	186	25
20-Jul	6	13	21	116	13
21-Jul	7	0	0	172	24
22-Jul	8	0	0	167	24
23-Jul	9	0	0	162	23
24-Jul	10	0	0	81	12
25-Jul	11	5	6	86	12
26-Jul	12	22	40	131	14
27-Jul	13	24	34	102	15
28-Jul	14	18	10	80	9
29-Jul	15	0	0	0	0
30-Jul	16	0	0	0	0
31-Jul	17	0	0	0	0
1-Aug	18	0	0	0	0
Total			372	1,880	85

APPENDIX B – data summaries and estimates of escapement of Chinook salmon from counting tower projects by Tanana Chiefs Conference on the Goodpaster River, 2007–2009.

Table B4.–Daily estimates of Goodpaster River Chinook salmon escapement, 2009.

Date	Day of Run	Number of 20 Min. Counts	Number Counted	Daily Escapement	Daily SE
7-Jul	1	3	1	6	-
8-Jul	2	24	4	12	5.9
9-Jul	3	24	8	24	7.9
10-Jul	4	24	22	66	17.1
11-Jul	5	24	36	108	37.4
12-Jul	6	24	15	45	14.0
13-Jul	7	24	46	138	35.6
14-Jul	8	23	57	181	38.9
15-Jul	9	24	87	261	57.3
16-Jul	10	24	100	300	36.9
17-Jul	11	24	103	309	53.5
18-Jul	12	24	78	234	37.4
19-Jul	13	23	126	394	58.4
20-Jul	14	24	92	276	40.6
21-Jul	15	24	107	321	34.6
22-Jul	16	24	75	225	28.3
23-Jul	17	24	101	303	39.3
24-Jul	18	24	72	216	27.0
25-Jul	19	24	67	201	40.2
26-Jul	20	24	77	231	35.3
27-Jul	21	24	49	147	25.1
28-Jul	22	24	37	111	22.2
29-Jul	23	24	41	123	22.7
30-Jul	24	24	16	48	20.5
Total	-	-	1,417	4,280	167